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GENERAL INSTRUMENT

Catalog of Optoelectronic Products 1980



Catalog of Optoelectronic Products 1980

GENERAL INSTRUMENT

Optoelectronics Division

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About General Instrument Optoelectronics____

Monsanto Optoelectronics

Experience

In 1969, when Monsanto entered into the world of optoelectronics, LED technology was crude, products were few, and experience limited. Since that time, Monsanto has developed into a leader in the marketplace. A leader because Monsanto has constantly sought innovation in product through research, and development.

10 years of effort are reflected in our experience in III-V material technology and development of optoelectronic products. The result—a continuing series of "firsts" in LED lamps, displays, and optoisolators.

Today, you can select from over 150 high performance devices in our product line. And no matter which product you choose, you are assured of high quality—quality that is designed into the product.

General Instrument Optoelectronics, Successor to Monsanto Optoelectronics

Continuity

And now our products, technology, services, and 10 years of experience will be under a new name—General Instrument Optoelectronics. In June, 1979 General Instrument acquired the total optoelectronics operations of Monsanto. This acquisition is a good marriage of companies, for General Instrument is already well known in semiconductor products and is now taking on another area of high technology. Their experience and dedication to the electronics business, combined with Monsanto's outstanding background, assures progress and growth.

In the meantime, continuity in all areas is promised to the customer. The same conscientious and dedicated people will continue to back in General Instrument's product line, giving you the same prompt product and technical it is stance, order processing and after-sale service whether you are dealing will our factory people, sales representatives, or one of our many stocking distributions.

Dedication

General Instrument is committed to providing total resources to become the leader in optoelectronics. What does that mean to the customer? An aggressive attitude in the areas you need most:

- 1) research and advancement of LED material
- 2) continued high quality standards
- 3) high performance products
- 4) a broad distribution system for fast delivery.
- 5) service to fill the customer's needs
- 6) product at a competitive price

Welcome to General Instrument Optoelectronics.

Customer Information

General Instrument Optoelectronics offers a complete sales network that is specifically organized to service the customer.

Distributors (page 253)

Stocking distributors are located throughout the

United States, Brazil, Canada, Europe,
Africa, Japan, Australia
to provide the customer with immediate availability of
product quantities of most standard products.

Sales Representatives (page 253) A large organization of highly qualified technical sales engineers is immediately available in all areas to offer assistance in design, concept, and product selection.

Product Marketing

An internal staff of product marketing personnel is available to provide further factory assistance. Organized by product area, they offer the customer broad experience and knowledge at the factory level.

Applications Engineering

Providing complete backup for applications assistance or discussion of specific problems, General Instrument engineers ensure that the customer has all information sources available to him.

About this Catalog

The General Instrument Optoelectronics catalog describes in detail our complete line of optoelectronic devices.

All of General Instrument's optoelectronic devices have been designed with your needs in mind, and offer you the easiest to use, and most available products on the market today. Using this directory, you should be able to meet virtually any requirement you will have for visible and infrared light emitting diodes; seven segment and alphanumeric displays; optoisolators; and emitters, detectors and sensors.

For your convenience, this catalog is divided into the five major product groups listed above. At the beginning of each product section you will find a selection guide which provides brief basic information on that product line to assist you in selecting the device best suited to your requirements. Full specification sheets are located further within that section.

For fast reference, an alpha-numeric product listing appears on page vii which lists all products individually, with applicable data sheet page numbers.

At the end of this catalog there is a technical section of application notes that will assist you in areas from testing to selecting your devices.

You should be able to find just what you need in this catalog. And we think you'll like what you find.

Thank you for your interest in General Instrument optoelectronic devices.

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LED Lamps_

PACKAGE SIZI (UNITS SHOWN ACTUAL SIZE)	DEVICE NO.	VIEWED COLOR LENS COLOR or TITLET	LUMINOUS IN HASHIY FORWARD CURRENT	VIEWING ANGLE	
TO-18	MV10B	Red/Clear	0.8 mcd @ 10mA	90°	
T-¾ <u>———</u>	MV50	Red/Clear	1.4 mcd @ 20mA		
	MV52	Green/Clear	1.5 mcd @ 20mA	80°	
	MV53	Yellow/Clear	1.5 mcd @ 20mA		
	MV54	Red/Flooded	1.0 mcd @ 20mA	100	
T-¾	MV55A	Bright Red	0.5 mcd @ 3mA	40°	
T-1¼*	MV5020 MV5021 MV5022 MV5023 MV5024 MV5025 MV5026	Red/Clear Red/Soft Red/Point Red/Soft Red/Soft Red/Flooded Red/Flooded	2.0 mcd @ 20mA 1.6 mcd @ 20mA 1.6 mcd @ 20mA 1.6 mcd @ 20mA 3.0 mcd @ 20mA 0.4 mcd @ 20mA 0.6 mcd @ 20mA	90° 90° 90° 60° 180° 90°	
	MV5050 MV5051 MV5052 MV5053 MV5055 MV5056	Red/Clear Red/Soft Red/Point Red/Flooded Red/Flooded Red/Flooded	2.0 mcd @ 20mA 1.6 mcd @ 20mA 2.0 mcd @ 20mA 1.6 mcd @ 20mA 0.6 mcd @ 20mA 0.8 mcd @ 20mA	50° 72° 72° 80° 150° 110°	
	MV5054-1 MV5054-2 MV5054-3	Red	2.0 mcd @ 10m'A 3.0 mcd @ 10mA 4.0 mcd @ 10mA	40°	
T-1	MV5074B/C		2.5 mcd @ 20mA 1.6 mcd @ 20mA	70° 90°	
	MV5077B/C	Red	1.7 mcd @ 20mA	110°	
T-1%*	MV5094	Red	0.8 mcd @ 20mA	50°	
T-1%*	MV5152 MV5153 MV5154	Orange	40.0 mcd @ 20mA 6.0 mcd @ 20mA 10.0 mcd @ 20mA	28° 65° 24°	
	MV5252 MV5253 MV5254	Green	15.0 mcd @ 20mA 3.5 mcd @ 20mA 3.0 mcd @ 20mA	28° 65° 24°	
	MV5352 MV5353 MV5354	Yellow	45.0 mcd @ 20mA 8.0 mcd @ 20mA 10.0 mcd @ 20mA	28° 65° 24°	
	MV5752 MV5753 MV5754	Bright Red	40.0 mcd @ 20mA 9.0 mcd @ 20mA 10.0 mcd @ 20mA	28° 65° 24°	
T-1	(a) MV5174B/C (b) MV5177B/C	Orange	5.0 mcd @ 20mA 3.0 mcd @ 20mA	90° 180°	
	(a) MV5274B/C (b) MV5277B/C	Green	1.8 mcd @ 20mA 0.9 mcd @ 20mA	90° 180°	_
	(a) MV5374B/C (b) MV5377B/C	Yellow	4.0 mcd @ 20mA 2.0 mcd @ 20mA	90° 180°	
	(a) MV5774B/C (b) MV5777B/C	Bright Red	5.0 mcd @ 20mA 3.0 mcd @ 20mA	90° 180°	
RECTANGULAR*	MV52124 MV53124 MV57124	Green Yellow Bright Red	3.0 mcd @ 20mA 4.0 mcd @ 20mA 4.0 mcd @ 20mA	100°	
T-1¾*	MV5491	Green/ Red	0.5 mcd @ 20mA 1.5 mcd @ 20mA	50°	

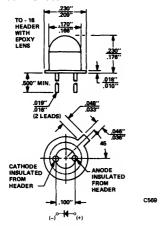
POWER	MAX DC CURRENT	FORWARD VOLFAGE	METHONS
175mW	70mA	1.65V	General purpose indicator lights compatible with Bipolar IC's.
80mW	40mA	1.65V	
105mW	35mA	2.20V	To disease Makes at the state of the state o
105mW	35mA	2.10V	Indicator lights, diagnostic and panel displays, printed circuit board indicators, miniature low profile package.
80mW	40mA	1.65V	
6mW	4mA	1.60V	Diagnostic or indicator lights in low-power/low current environments, MOS compatible
		1.65V	
180mW	100mA	1.70V	Instruments, printed circuit board indicators, board-mounted panel display, different lens effect and viewin angles. MVS 020 series offers leads with standoffs for assembly ease. General purpose indicators.
		1.80V	
100mW	50mA	1.68V	General purpose indicators, developmental projects, breadboards.
	001	1.06 ¥	Miniature indicators, breadboards, test jigs. Low profile
140mW	70mA	1.60V	High voltage bi-directional AC indicators, power supplied transformers.
		2.00V	
		2.20V	Computers, general purpose indicators, instruments, tes systems, mini- and micro-processors, process controlled
		2.10V	industrial systems, sorting machines, assembly equip- ment, vending machines, telephone equipment, back- light panels. High intensity indicators in four colors.
105mW	35mA	2.00V	
		2.00V	
		2.20V	Portable equipment, general purpose indicators and matrix panel displays, test equipment and systems,
		2.10V	sorting machines, vending machines. High intensity indicators in four colors.
		2.00V	
105mW	35mA	2.00V	Legend backlight, panel indicator, bar graph, display button. Mounting hardware available.
200mW	35mA 70mA	3.00V 1.65V	Polarity indication tri-state indicator, flow direction display, instruments, tester displays, educational aids.

MV10B RED LED

PRODUCT DESCRIPTION

The MV10B is a GaAsP light emitting diode mounted on a TO18 header with a clear epoxy lens. On forward bias, it emits a spectrally narrow band of radiation which peaks at 660 nm.

PACKAGE DIMENSIONS



FEATURES

- Ultra High Brightness
- Long Life Solid State Reliability
- Low Power Requirements
- Compatible with Integrated Circuits DTL, RTL, T²L.
- · Compact, Rugged, Lightweight.

ABSOLUTE MAXIMUM RATINGS

Power Dissipation @ 25°C Ambient Temperature	175mW
Derate Linearly from 25°C	2.33mW/°C
Storage & Operating Temperature	-55°C to +100°C
Lead Solder Time @ 260°C (See note 2)	7.0 s
Continuous Forward Current	70mA
Peak Forward Current (1 μsec pulse, 0.3% duty cycle)	1.0A
Reverse Voltage	5.0V

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

CHARACTERISTICS	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity (see note 1)	0.8		mcd	I _E = 10 mA
Peak emission wave length	660	700	nm	•
Spectral line half width	20		nm	
Forward voltage	1.65	2.0	V	I _F = 50 mA
Forward dynamic resistance	2.0		Ω	I _E = 50 mA
Capacitance	135		pF	V = 0

ELECTRO-OPTICAL CHARACTERISTICS (Continued)

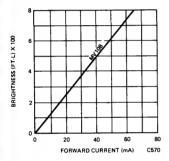
CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Light rise time and fall time		50		ns	50Ω system, $I_F = 50 \text{ mA}$
Reverse current		50		nA	V _R = 3.0 V
Reverse breakdown voltage	3	15		V	$I_R = 100 \mu A$
Luminous Flux		3.7		mLumens	I _F = 50 mA
View angle		90		Degrees	Between 50% Points

TYPICAL THERMAL CHARACTERISTICS

Thermal Resistance Junction to Free Air (θ_{JA})	0° C/W
Thormal Basistance Junction to Case IA.	5 C/W
144 to the Towns of the Conficient (conficient towns or the Conficient Confic	11111/ C
Forward Voltage Temperature Coefficient2.0	mv/ C

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS CURVES

(25°C Free Air Temperature)



150 125 125 100 25 50 25 50 AMBIENT TEMPERATURE (°C)

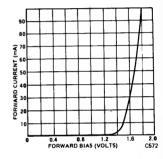
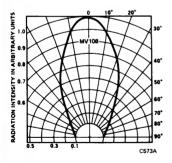
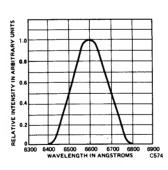


Figure 1 Brightness vs. Forward Current

Figure 2 Brightness vs. Temperature

Figure 3 Forward Current vs. Forward Voltage





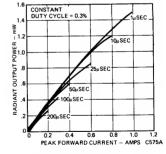


Figure 4 Spatial Distribution (Note 3)

Figure 5 Spectral Distribution

Figure 6 Peak Power Output vs. Pulsed Forward Current

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NOTES

- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- The leads of the MV10B were immersed in molten solder, heated to 260°C, to a point 1/16-inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

3. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.

GENERAL INSTRUMENT Optoelectronics

MV50 MV54 RED LED

CARL CONTRACTOR

PRODUCT DESCRIPTION

The MV50 and MV54 are diffused Gallium Arsenide Phosphide diodes mounted in a two lead epoxy package; the MV50 has a clear lens; the MV54 is red diffused. On forward bias they emit a spectrally narrow band of visible light which peaks at 660 nm. (Also see MV55A.)

GREEN MARK INDICATES CATHODE (+) 0.025 ANODE (+) 0.080

FEATURES

The MV50 and MV54 are intended for high volume indicator light applications where low cost, high reliability, and top performance are required. Major usage is in applications such as diagnostic lights on printed circuit boards and panel lights. They can be used to displace subminiature lamps as small as T3/4 size.

- Low cost
- Bright
- Compatible with integrated circuits
- Long life, rugged
- Small size T3/4
- Easily assembled in arrays

ABSOLUTE MAXIMUM RATINGS

THE REPORT OF THE PROPERTY OF

Power dissipation @ 25°C ambient	80 mW
Derate linearly from 25°C	1.6 mW/°C
Storage and operating temperature	
Peak forward current (1 μsec pulse width, 0.3% duty cycle)	1.0A
Lead solder time @ 230° (note 1)	5 sec
Continuous forward current	40 mA
Reverse Voltage	5.0 V

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

CHARACTERISTICS		MINIMUM TYPICAL		CAL	MAXIMUM	UNITS	TEST CONDITIONS	
		MV50	MV54	MV50	MV54	MV50/54		
	Luminous Intensity (note 2)*	0.5	0.4	1.4	1.0		mcd	I _F = 20 mA
	Peak emission wavelength			660	660		nm	I _F = 20 mA
	Spectral line halfwidth			20	20		nm	l _F = 20 mA
	Forward voltage			1.65	1.65	2.0	٧	I _F = 20 mA
	Capacitance			80	80		pF	V = 0
	Rise and fall time			50	50		ns	50 Ω system,
								I _F = 20 mA
	Reverse current			5.0	5.0		nΑ	V _R = 3.0 V
	Reverse breakdown voltage	5		15	15		V	$I_{R} = 100 \mu A$
	View angle			80	80		degrees	between 50%
								points

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL THERMAL CHARACTERISTICS

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature)

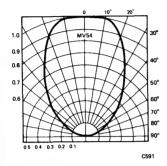


Figure 1 Spatial Distribution (Note 3)

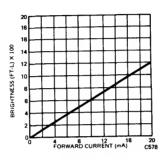


Figure 2 Brightness vs. Forward Current

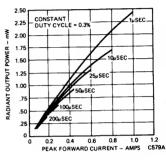


Figure 3 Peak Power Output vs. **Pulsed Forward Current**

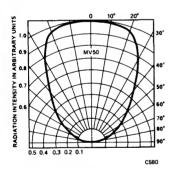


Figure 4 Spatial Distribution (Note 3)

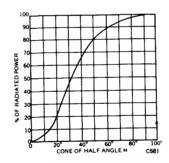


Figure 5 Percent Radiated Power Into Cone of Half Angle

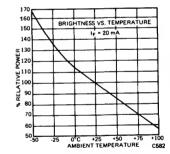


Figure 6 Relative Power vs. Temperature

NOTES

- 1. The leads of the device were immersed in molten solder at 230°C to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.
- 2. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 3. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.

GREEN MV52 YELLOW MV53 LIGHT EMITTING DIODES

PRODUCT DESCRIPTION

The MV52 is a Gallium Phosphide diode mounted in a two lead green epoxy package. The MV53 is a Gallium Arsenide Phosphide diode mounted in a two lead yellow epoxy package. The identical mechanical configuration is also available in a red lamp, part number MV50 or MV54.

PACKAGE DIMENSIONS .250 MIN 2 PLCS. GREEN MARK CATHODE ANODE 025 090 080 060 050 OR 010 : 001 0583 TOLERANCES ± 010 UNLESS SPECIFIED NOTE NOTE: ALL DIMENSIONS IN INCHES

FEATURES

The MV52 and MV53 units are intended for high volume indicator light applications where high reliability and top performance are required. Major usage is in applications such as diagnostic lights on printed circuit boards and panel lights. The units can be used to displace subminiature lamps as small as T3/4 size.

- MULTICOLORED VERSIONS OF THE POPULAR MV50 PACKAGE
- Low cost
- Bright
- Compatible with integrated circuits
- Long life, rugged
- Small size T3/4

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	105 mW
Derate linearly from 25°C	mW/°C
Storage and operating temperature	100°C
Lead solder time @ 230°C (See note 3)	. 5 sec
Continuous forward current	
Reverse Voltage	. 5.0 V

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

CHARACTERISTICS	MINIMUM	TYPICAL	MAXIMUM	UNITS	TEST CONDITIONS
Luminous Intensity (Note 1)*	0.2	1.0		mcd	I _F = 20 mA
Peak emission wavelength, MV52		565		nm	$I_F = 20 \text{ mA}$
Peak emission wavelength, MV53		589		nm	I _F = 20 mA
Spectral line halfwidth MV52, MV53		35		nm	I _F = 20 mA
Forward voltage MV52		2.2	3.0	V	I _F = 20 mA
MV53		2.1	3.0	V	I _F = 20 mA
Reverse breakdown voltage	5	15		V	$I_{R} = 100 \mu A$
Forward voltage temp. coefficient		-3.0		mV/°C	I _F = 20 mA
Viewing angle		80		degrees	between 50% points

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature)

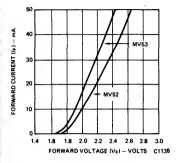


Fig. 1. Forward Current vs. Forward Voltage

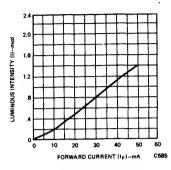


Fig. 2. Luminous Intensity vs. Forward Current

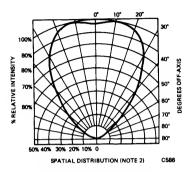


Fig. 3 Spatial Distribution (Note 2)

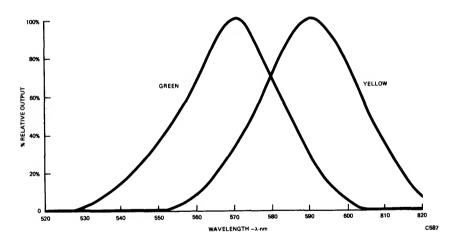


Fig. 4. MV52-MV53 Spectral Response

NOTES

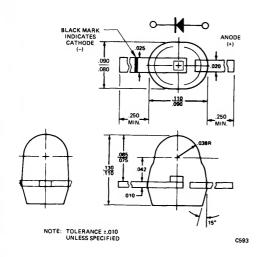
- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 3. The leads of the device were immersed in molten solder at 230°C to a point 1/16 inch from the body of the device per MIL-S-750 with a dwell time of 5 seconds.

MV55A RED LED

PRODUCT DESCRIPTION:

The MV55A is a gallium arsenide phosphide device useful for low current drive (5 mA) applications, such as diagnostic functions or indicators.

PACKAGE DIMENSIONS



FEATURES

MV55A is intended as a low cost, high reliability indicator lamp.

- Low cost
- Compatible with integrated circuits.
- Small size
- · High on axis intensity.
- 2 Gate Load Bright Light
- MOS compatible

ABSOLUTE MAXIMUM RATINGS

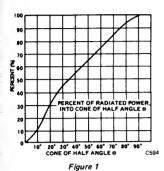
Power dissipation @ 25°C ambient	105 mW
Derate linearly from 25°C	1.3 mW/°C
Storage & operating temperature	55°C += 100°C
Lead solder time @ 230°C (See Note 1)	
Continuous forward current	
Reverse voltage	50 V
Peak forward current (1 μsec pulse, 0.1% duty cycle)	400 mA

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity (Note 3)*	0.2	0.5 2.0		mcd	IF = 5.0 mA
Peak emission wave length		635		mcd nm	I _F = 20 mA
Spectral line half-width		45		nm	
Forward voltage		1.6 2.2	2.0	V V	l _F = 5.0 mA l _F = 20 mA
Reverse current		.15	10	μΑ	$V_R = 3.0 \text{ volts}$
Light turn-on and turn-off		1		ns	$Z = 1\Omega$ system
Capacitance		20		pF	V = 0
Reverse breakdown voltage	3			V	$I_F = 10 \mu A$
*Luminous intensity guaranteed to a 2.59	% AQL inspection	n plan per MIL-S7	D-105D.		· ·

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature)



SPATIAL DISTRIBUTION C595

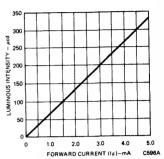
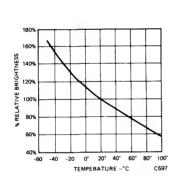
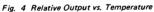


Figure 2 (Note 2)

Fig. 3 Luminous Intensity vs. Forward Current





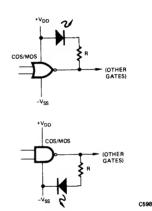


Fig. 5 MV55A Interfaced with COS/MOS

NOTES

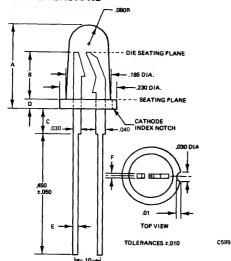
- 1. The leads of the device were immersed in molten solder, heated to a temperature of 230°C, to a point 1/16 inch from the body of the device per MIL-S-750, with dwell time of 5 sec.
- 2. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 3. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).

MV5020 SERIES RED SOLID STATE LAMPS

PRODUCT DESCRIPTION

The MV5020 series of solid state indicators is made with gallium arsenide phosphide light-emitting diodes. Encapsulation and lens is epoxy. Various lens effects are available for many indicator applications.

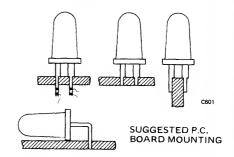
PACKAGE DIMENSIONS



FEATURES

- Low cost
- High intensity red light source with various lens colors and effects
- Versatile mounting on PC board or panel
- Snap in panel mounting clip available (See MP21 and MP22 for clip detail)

BOARD MOUNTING



ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	180 mW
Derate linearly from 25°C	2 mW/°C
Storage and operating temperatures	°C to 100°C
Lead solder time @ 260°C (Note 2)	5 coc
Continuous forward current @ 25°C	100 mA
Continuous forward current @ 100°C	20 mA
Peak forward current (1 µsec pulse, 0.3% duty cycle)	1 Λ Δ
Reverse voltage	5.0 V

PHYSICAL CHARACTERISTICS

TYPE	A	В	С	D	E & F	SOURCE COLOR	LENS COLOR	LENS EFFECT	POP-IN MOUNTING	CIRCUIT BOARD MOUNTING
MV5020	.340	.190	.100	.040	.025	RED	CLEAR	POINT	×	×
MV5021	.340	.190	.100	.040	.025	RED	CLEAR DIFF.	SOFT	×	×
MV5022	.340	.190	.100	.040	.025	RED	TRANS, RED	POINT	×	×
MV5023	.340	.190	.100	.040	.025	RED	RED DIFF.	SOFT	×	×
MV5024	.340	.160	.130	.040	.025	RED	RED DIFF.	\$OFT FLOODED	×	×
MV5025	.340	.160	.130	.040	.025	RED	RED DIFF.	FLOODED	×	×
MV5026	.340	.160	.130	.040	.025	RED	DK. RED DIFF,	FLOODED	×	×

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

DAI	RAMETER	TEST COND.	UNITS	5020	5021	5022	5023	5024	5025	5026
		20 mA	mcd	0.6	0.5	0.6	0.4	0.9	0.1	0.1
Luminous Intensity-		20 mA	mcd	2.0	1.6	1.6	1.6	3.0	.4	.6
	Typ. (Note 1)	20 mA	nm	660	660	660	660	660	660	660
Peak Wave Length	r .115	20 mA	nm	20	20	20	20	20	20	20
Spectral Line Half W		20 mA	V	1.65	1.65			1.65	1.65	1.65
Forward Voltage	Тур.	20 mA	v	2.0	2.0	2.0	2.0	2.0	2.0	2.0
VF	Max.	V _R = 5.0 V	nA	15	15	15	15	15	15	15
Reverse Current IR	Тур.	$V_R = 5.0 \text{ V}$	μA	100	100	100	100	100	100	100
	Max.	$V_R = 3.0 V$ $I_R = 100 \mu A$	μ V	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Reverse Voltage VR		I _R = 100μΑ	V	10.0	• • • •			10.0	10.0	10.0
	Тур.	V = 0	pF	35	35	35	35	35	35	35
Capacitance	Тур.	Between	p.	50	-	•				
View Angle		50% Points	Degrees	90	90	90	90	60	180	90
Rise Time		10 %- 90 % 50Ω system	nsec	50	50	50	50	50	50	50
& Fall Time	Тур.	$90\%\text{-}10\%$ 50Ω system	nsec	50	50	50	50	50	50	50

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

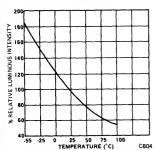


Fig. 1. Luminous Intensity vs. Temperature

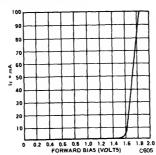
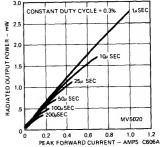


Fig. 2. Forward Current vs. Forward Voltage



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Fig. 3. Radiated Output Power vs. Peak Forward Current

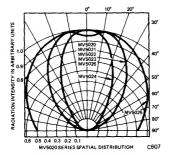


Fig. 4. Spatial Distribution

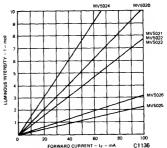


Fig. 5. Luminous Intensity vs. Forward Current

NOTES

- 1. As measured with a Photo Research Corp., "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The leads of the device were immersed in molten solder at 260°C to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

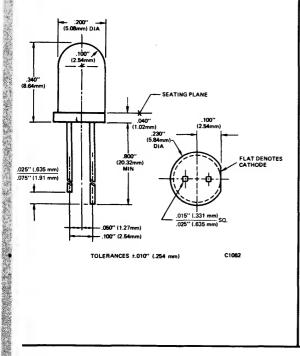
RED SOLID STATE LAMPS

MV5050 MV5053 MV5051 MV5055 MV5052 MV5056

PRODUCT DESCRIPTION

The MV5050 series of solid state indicators is made with Gallium Arsenide Phosphide light emitting diodes encapsulated in epoxy lenses. Various lens effects are pleasing in different design settings.

PACKAGE DIMENSIONS



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FEATURES

- High intensity red light source with various lens colors and effects
- Versatile mounting on P.C. board or panel
- Snap in mounting grommet available on request
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight
- Upon request, also available with anode lead trimmed longer than cathode.

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	POP-IN MOUNTING	CIRCUIT BOARD MOUNTING
MV5050	Red	Clear	Point	×	×
MV5051	Red	Diffused	Soft	×	×
MV5052	Red	Trans. Red	Point	×	×
MV5053	Red	Red Diffused	Flooded	×	×
MV5055	Red	Red Diffused	Flooded	×	×
MV5056	Red	Dark Red Diffused	Flooded	×	×

MV5050 5051 5052 5053 5055 5056

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

PARAMETER	TEST COND.	UNITS	5050	5051	5052	5053	5055	5056
Forward Voltage (V _F) Typ. Max.	I _F = 20 mA I _F = 20 mA	v v	1.7 2.2	1.7 2.2	1.7 2.2	1.7 2.2	1.7 2.2	1.7 2.2
Luminous Intensity* (See note 1) Typ. Min.	I _F = 20 mA I _F = 20 mA	mcd mcd	2.0 0.5	1.6 0.4	2.0 0.7	1.6 0.5	.6 0.1	.8 0.2
Peak Wave Length Spectral Line Half Width	I _F = 20 mA I _F = 20 mA	nm nm	670 20	670 20	670 20	670 20	670 20	670 20
Capacitance Typ.	V = 0	pF	30	30	30	30	30	30
Reverse Voltage (V _R) Min. Typ.	ι _R = 100μΑ ι _R = 100μΑ	v v	5 25	5 25	5 25	5 25	5 25	5 25
Reverse Current (I _R) Max. Typ.	V _R = 5.0V V _R = 5.0V	μA nA	100 20	100 15	100 5	100 5	100 5	100 5
Rise Time	10%-90% 50Ω system 90%-10%	nsec nsec	50 50	50 50	50 50	50 50	50 50	50 50
Fall Time Viewing Angle	50Ω system See Fig. 5 & 6	degrees	50	72	72	80	150	110

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	180 mW
Power dissipation @ 25 C ambient	2.0 mW/°C
Derate linearly from 25°C	-55°C to 100°C
Storage and operating temperatures	5 sec
Lead colder time @ 260°C (See Note 3)	
Continuous forward current @ 25°C	15 mA
Continuous forward current @ 100°C	10A
Peak forward current (1 µsec pulse, 0.3% duty cycle)	5
Reverse voltage	

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

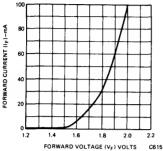


Fig. 1. Forward Current vs. Forward Voltage

(M)

200

RADIATED OUTPUT POWER



C617

Fig. 3. ROP vs. Forward Current

FORWARD CURRENT (mA)

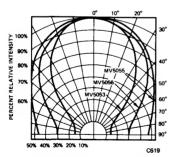


Fig. 5. Spatial Distribution (Note 2) (MV5053, MV5055, MV5056)

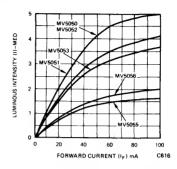


Fig. 2. Luminous Intensity vs. Forward Current

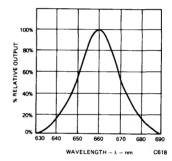


Fig. 4. Spectral Response

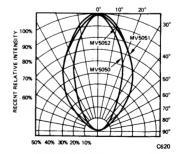


Fig. 6. Spatial Distribution (Note 2) (MV5050, MV5051, MV5052)

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NOTES

- 1. As measured with a Photo Research Corp., "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 3. The leads of the device were immersed in molten solder at 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

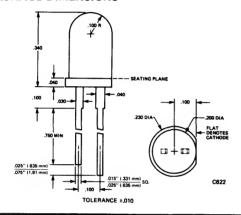
RED SOLID STATE LAMPS

MV5054-1 MV5054-2 MV5054-3

PRODUCT DESCRIPTION

The MV5054 series lamps are made with gallium arsenide phosphide diodes mounted in a red epoxy package.

PACKAGE DIMENSIONS



FEATURES

- Three light intensity categories
- Illuminates a ¼" dia. circle
- High intensity red light source for back lighting a panel
- Versatile mounting on PC board
- Transparent mounting grommet available

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	mW
Derate linearly from 25°C	/°C
Storage and operating temperatures)°C
Lead solder time @ 230°C (See Note 3)	sec
Continuous forward current @ 25°C	mΑ
Continuous forward current @ 100°C	mΑ
Peak forward current (1 μsec pulse, 0.3% duty cycle)	0 A
Reverse Voltage	
Reverse current	

ELECTRO-OPTICAL CHARAC	(25°C Amt	oient Temperatu	ıre),		
CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
*Luminous intensity (Note 1)					
MV5054-1	1.0	2.0		mcd	i _F = 10 mA
MV5054-2	2.0	3.0		mcd	I _F = 10 mA
MV5054-3	3.0	4.0		mcd	I _F = 10 mA
Forward voltage		1.8	2.2	V	I _F = 10 mA
Capacitan ce		35		pF	· V = 0
Reverse current			100	μA	$V_{p} = 5.0 \text{ V}$
Rise and fall time		50		nS	50 Ω System
Viewing angle (total)		40		degrees	Between 50% intensity points

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

20

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

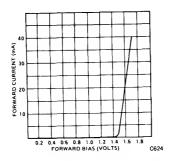


Fig. 2. Forward Current vs. Forward Voltage

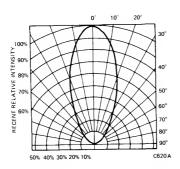


Fig. 4. Spatial Distribution (Note 2)

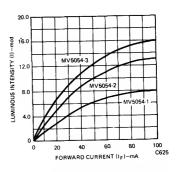


Fig. 3. Luminous Intensity vs. Forward Current

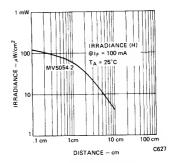


Fig. 5. Irradiance vs. Distance

NOTES

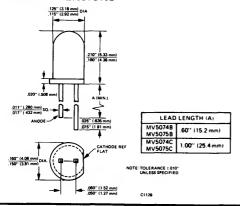
- 1. As measured with a Photo Research Corp., "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 3. The leads of the deivce were immersed in molten solder at 230°C to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

MV5074B/C MV5075B/C RED SOLID STATE LAMP

PRODUCT DESCRIPTION

The MV5074B/C and MV5075B/C are red (GaAsP) light emitting diodes mounted in a red epoxy package. Their small size (approximately T-1 size), good viewing angle, and small square leads contribute to their versatility as all purpose indicators.

PACKAGE DIMENSIONS



FEATURES

- Square leads (will fit into .020" (.508 mm) diameter hole)
- Compact size
- Bright (typically 2.0 mcd at 20 mA)
- Long life, rugged
- MV5074B and MV5075B have .6" (15.2 mm) minimum lead length
- MV5074C and MV5075C have 1" (25.4 mm) minimum lead length
- Mount on approximately 3/16" (4.72 mm) centers
- Upon request, also available with anode lead trimmed longer than cathode.

ABSOLUTE MAXIMUM RATINGS

Power Dissipation @ 25°C	,
Derate Linearly from 25°C	
Storage Temperature	•
Operating Temperature	:
Continuous Forward Current (25°C)	
Peak Forward Current (1 μsec Pulse Width, 0.3% Duty Cycle)	
Reverse Voltage 5.0 Volts	
Lead Solder Time 260°C (See Note 2)	

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature) TEST CHARACTERISTICS MIN. CONDITIONS TYP. MAX. UNITS Optical Luminous Intensity (I) (Note 1)* MV5074B/C 0.7 2.5 mcd $I_F = 20 \text{ mA}$ MV5075B/C 0.6 1.6 mcd IF = 20 mA Wavelength (λpk) 660 nm Spectral Half Width 20 nm Viewing Angle MV5074B/C 70 Between 50% points degrees MV5075B/C 90 degrees Between 50% points **Electrical** Forward Voltage (V_F) 1.68 2.0 Volts $I_F = 20 \text{ mA}$ Reverse Voltage (VR) 5.0 15.0 $I_R = 100 \mu A$ Volts Dynamic Resistance (RD) 7.0 Ω Capacitance 23 рF V = 0

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

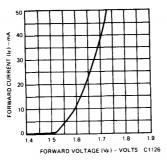


Fig. 1. Forward Current vs. Forward Voltage

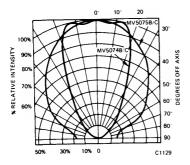


Fig. 3. Spatial Distribution

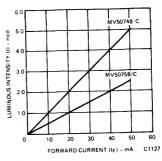


Fig. 2. Luminous Intensity vs. Forward Current

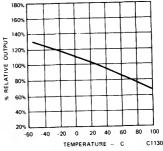


Fig. 4. Percent Relative Response vs. Temperature

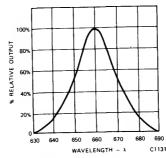


Fig. 5. Spectral Response

NOTES

- 1. As measured with a Photo Research Corp., "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The leads of the device were immersed in molten solder at 260°C to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

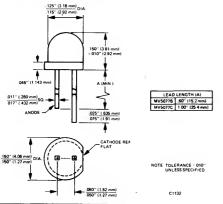
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MV5077B MV5077C RED SOLID STATE LAMP

PRODUCT DESCRIPTION

The MV5077B and MV5077C are red (GaAsP) light emitting diodes mounted in a red epoxy package. Their small size (approximately T-1 size), good viewing angle, and small square leads contribute to their versatility as all purpose indicators.

PACKAGE DIMENSIONS



FEATURES

 Square leads (will fit into .020" (.508 mm) diameter hole)

- Compact size
- Bright (typically 1.75 mcd at 20 mA)
- Long life, rugged
- MV5077B have .6" (15.2 mm) minimum lead length
- MV5077C have 1" (25.4 mm) minimum lead length
- Mount on approximately 3/16" (4.72 mm) centers
- Upon request, also available with anode lead trimmed longer than cathode

ABSOLUTE MAXIMUM RATINGS

Power Dissipation @ 25°C
Derate Linearly from 25 C · · · · · · · · · · · · · · · · · ·
Storage Temperature55°C to +100°C
Operating Temperature55°C to +100°C
Continuous Forward Current (25°C)
reak Forward Current (1 μsec Fulse Width, 0.3% Duty Cycle)
Reverse voitage 5 0 Volts
Lead Solder Time 260°C (See Note 2)

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Optical					
Luminous Intensity (I) (Note 1)*	0.3	1.75		mcd	I _F = 20 mA
.Wavelength (λpk)		660		nm	I _F = 20 mA
Spectral Half Width		20		nm	I _F = 20 mA
Viewing Angle		110		degrees	Between 50% points
Electrical				•	
Forward Voltage (V _F)		1.68	2.0	Volts	I _F = 20 mA
Reverse Voltage (V _R)	5.0	15.0		Volts	$I_{P} = 100 \mu A$
Dynamic Resistance (R _D)		7.0		Ω	K ==== p
Capacitance		23		pF	V = 0

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

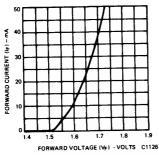


Fig. 1. Forward Current vs. Forward Voltage

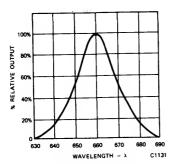


Fig. 3. Spectral Response

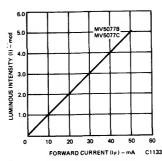


Fig. 2. Luminous Intensity vs. Forward Current

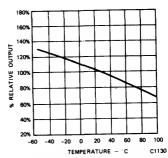


Fig. 4. Percent Relative Response vs. Temperature

NOTES

- 1. As measured with a Photo Research Corp., "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The leads of the device were immersed in molten solder at 260°C to a point 1/16 inch from the device per MIL-S-750, with a dwell time of 5 seconds.

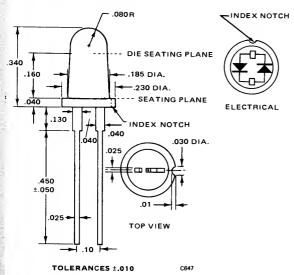
MV5094 RED BIPOLAR SOLID STATE LAMP

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PRODUCT DESCRIPTION

The MV5094 is the first commercially available solid state AC-DC lamp. Reliability, long life, plus a convenient panel mounting enable this red lamp to be run from A.C. voltages even as high as 110-115 V.

PACKAGE DIMENSIONS



FEATURES

- Solid state
- A.C. lamp
- 110-115 VAC operation (see chart)
- Versatile mounting on P.C. board or panel
- Convenient mounting grommet available
- Cool operation
- Long life
- This lamp mounts in the MP21 or MP22 grommet.

ABSOLUTE MAXIMUM RATINGS

Power Dissipation @ 25°C (Peak or continuous)	nW
Storage and Operating Temperature	۰°۰
A.C., pmes/D.C. Forward Current 25°C	
A.C., page, /D.C. Forward Current 100°C	-
1 ² T (0.1% Duty Cycle)	nA
	sec
Lead Solder time 200 C (See Note 3)	CAC

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS (25°C Ambient Temperature Unless Stated Otherwise)

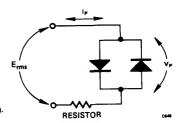
	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Luminous Intensity (1) (Note 1)		.8		mcd	I _F = 20 mA
Forward Voltage (V _F)		1.6	2.0	volts	I _F = 20 mA

AC OPERATION

ERMS	i _F = 10 mA, V _F = 1.56	Ip = 25 mA, Vp = 1.62	i _F = 50 mA, V _F = 1.66	I _F = 70 mA, V _F = 1.70
	RESISTOR	RESISTOR	RESISTOR	RESISTOR
5.0 6.3 9.0 12.0 15.0 18.0 24.0 28.0 48.0 110.0	360 Ω, 1/8 W 470 Ω, 1/8 W 750 Ω, 1/8 W 1.0 KΩ, 1/8 W 1.3 KΩ, 1/4 W 2.2 KΩ, 1/4 W 2.7 KΩ, 1/2 W 4.7 KΩ, 1/2 W 11.0 KΩ, 2 W	130 Ω, 1/8 W 180 Ω, 1/8 W 300 Ω, 1/4 W 430 Ω, 1/2 W 560 Ω, 1/2 W 910 Ω, 1 W 1.1 ΚΩ, 1 W 1.8 ΚΩ, 2 W	68 Ω, 1/4 W 100 Ω, 1/4 W 150 Ω, 1/2 W 200 Ω, 1/2 W 270 Ω, 1 W 330 Ω, 1 W 470 Ω, 2 W 550 Ω, 2 W	51 Ω, 1/4 W 68 Ω, 1/2 W 110 Ω, 1 W 150 Ω, 1 W 200 Ω, 1 W 240 Ω, 2 W 330 Ω, 2 W 390 Ω, 2 W

Resistor values are nearest commercially available.

IF corresponds to a desired brightness level (from fig. 2). V_P corresponds to the voltage across the device (from fig. 1).



TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

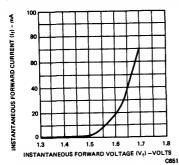


Fig. 1. Forward Current vs. Forward Voltage

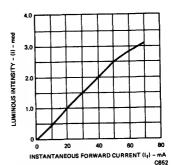


Fig. 2. Luminous Intensity vs. Forward Current

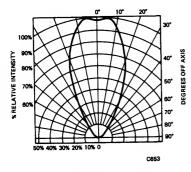


Fig. 3. Spatial Distribution

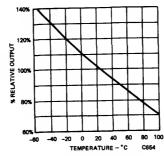
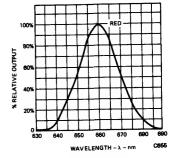


Fig. 4. Output vs. Temperature



Flg. 5. Spectral Distribution

NOTES

- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. Values of Luminous Intensity may begin to decrease for operation above 25 KHz.
- 3. The leads of the device were immersed in molten solder at 260°C to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

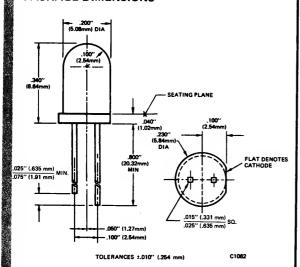
GENERAL INSTRUMENT Optoelectronics

SOLID STATE LAMPS ORANGE GREEN YELLOW HIGH EFFICIENCY RED MV5152 MV5252 MV5352 MV5752

PRODUCT DESCRIPTION

These solid state indicators offer high brightness and color availability. The orange and yellow devices are made with gallium arsenide phosphide on gallium phosphide; the green units are made with gallium phosphide on gallium phosphide. The red units are made with gallium arsenide phosphide on gallium arsenide.

PACKAGE DIMENSIONS



FEATURES

- High efficiency GaP light sources
- See MV5050 series for other red sources.
- Versatile mounting on P.C. board or panel
- Snap in grommet available on request
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight
- Upon request, also available with anode lead trimmed longer than cathode.

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	15 mW
Delate inlearly from 25 C	~\A//°C
Lead solder time @ 260°C (See Note 3)	
Continuous for ward current w 25 C	3 E A
Continuous forward current @ 100 C	10 0
reak forward current (1 µsec pulse, 0.3% duty cycle)	100
Reverse voltage	50 1

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	POP-IN MOUNTING	CIRCUIT BOARD MOUNTING
MV5152	Orange	Clear orange	Narrow beam; point source	×	x
MV5252	Green	Clear green	Narrow beam; point source	×	×
MV5352	Yellow	Clear yellow	Narrow beam; point source	×	×
MV5752	Red	Clear red	Narrow beam; point source	×	×

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ECTRO-OPTICAL CH	IARACTERISTICS	(25°C Free	Air Temperati	ire)		
PARAMETER	TEST COND.	UNITS	MV5152	MV5252	MV5352	MV5752
Forward voltage (V _F)		.,	2.0	2.2	2.1	2.0
Typ.	I _F = 20 mA	V		3.0	3.0	3.0
Max.	$I_F = 20 \text{ mA}$	V	3.0	3.0	3.0	- 0.0
_uminous intensity (see N	ote 1)*				10.0	17.0
Min.	$I_F = 20 \text{ mA}$	mcd	17.0	2.0	10.0	40.0
Typ.	$I_F = 20 \text{ mA}$	mcd	40.0	15.0	45.0	
Peak wave length	20 mA	nm	635	565	585	635
	20 mA	nm	45	35	35	45
Spectral line	20 11174					
Half width						
Capacitance			45	45	45	45
Тур.	V = 0	рF	43	43		
Reverse voltage (V _R)			-	5	5	5
Min.	$I_{R} = 100 \mu A$	V	5		25	25
Typ.	$I_{R} = 100 \mu A$	V	25	25	25	23
Reverse current (I _R)					100	100
Max.	$V_{R} = 5.0 \text{ V}$	μΑ	100	100	100	
Тур.	VR = 5.0 V	nА	20	20	20	20
Viewing angle (total)	See Fig. 3 & 4	degrees	28	28	28	28

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

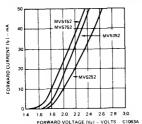


Fig. 1. Forward Current vs. Forward Voltage

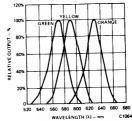


Fig. 2. Spectral Response

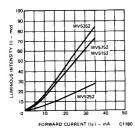


Fig. 3. Luminous Intensity vs. Forward Current

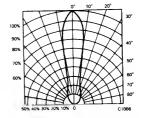


Fig. 4. Spatial Distribution (Note 2) (MV5352, MV5252, MV5152, MV5752)

NOTES

- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The axes of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 3. The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

GENERAL INSTRUMENT Optoelectronics

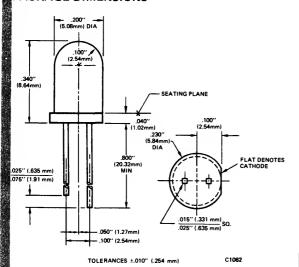
SOLID STATE LAMPS GREEN YELLOW RED

ORANGE MV5153 MV5154 MV5253 MV5254 MV5353 MV5354 MV5753 MV5754

PRODUCT DESCRIPTION

These solid state indicators offer a variety of lens effects and color availability. The orange and yellow devices are made with gallium arsenide phosphide on gallium phosphide; the green units are made with gallium phosphide on gallium phosphide. The red units are made with gallium arsenide phosphide on gallium arsenide.

PACKAGE DIMENSIONS



FEATURES

- High efficiency GaP light source with various lens effects
- Versatile mounting on P.C. board or panel
- Snap in grommet available on request
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight
- Upon request, also available with anode lead trimmed longer than cathode.

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient
Derate linearly from 25°C
Storage and operating temperatures55°C to 100°C
Lead solder time @ 260°C (See Note 3)
Continuous forward current @ 25°C
Continuous forward current @ 100°C
Peak forward current (1 µsec pulse, 0.3% duty cycle)
Reverse voltage

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	POP-IN MOUNTING	CIRCUIT BOARD MOUNTING
MV5153	Orange	Orange diffused	Wide beam	X	×
MV5154	Orange	Orange diffuseo	Narrow beam	X	×
MV5253	Green	Green diffused	Wide beam	×	X
MV5254	Green	Green diffused	Narrow beam	×	X
MV5353	Yellow	Yellow diffused	Wide beam	×	X
MV5354	Yellow	Yellow diffused	Narrow beam	X	X
MV5753	Red	Red diffused	Wide beam	X	X
MV5754	Red	Red diffused	Narrow beam	X	×

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)										
PARAMETER	TEST COND.	UNITS	MV5153	MV5154	MV5253	MV5254	MV5353	MV5354	MV5753	MV5754
Forward voltage (V _F)										
Typ.	I _F = 20 mA	V	2.0	2.0	2.2	2.2	2.1	2.1	2.0	2.0
Max.	I _F = 20 mA	V	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Luminous intensity (S	ee Note 1)*									
Min.	$I_F = 20 \text{ mA}$	mcd	3.0	3.0	8.0	0.9	2.5	3.0	3.0	3.0
Тур.	I _F = 20 mA	mcd	6.0	8.0	1.5	3.0	6.0	10,0	6.0	8.0
Peak wave length	i _F = 20 mA	nm	635	635	565	565	585	585	635	635
Spectral line	I _E = 20 mA	nm	45	45	35	35	35	35	45	45
Half width	•									
Capacitance									45	45
Тур.	V = 0	рF	45	45	45	45	45	45	45	45
Reverse voltage (VR)							_	_	-	5
Min.	$I_R = 100 \mu A$	V	5	5	5	5	5	5	5	
Тур.	I _R = 100 μA	V	25	25	25	25	25	25	25	25
Reverse current (IR)									400	100
Max.	$V_{R} = 5.0 V$	μΑ	100	100	100	100	100	100	100	
Тур.	$V_{R} = 5.0 \text{ V}$	nΑ	20	20	20	20	20	20	20	20
Viewing angle (total)	See Fig. 3 & 4	degrees	65	24	65	24	65	24	65	24

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

*Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

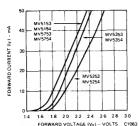
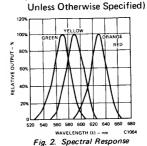


Fig. 1. Forward Current vs. Forward Voltage



(25°C Free Air Temperature

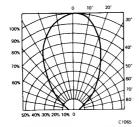


Fig. 3. Spatial Distribution (Note 2) (MV5353, MV5253, MV5153, MV5753)

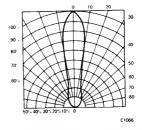


Fig. 4. Spatial Distribution (Note 2) (MV5354, MV5254, MV5154, MV5754)

NOTES

- 1. As measured with Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The axes of spatial distribution are typically with a 10° cone with reference to the central axis of the device.
- 3. The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

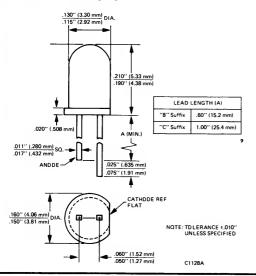
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GENERAL INSTRUMENT Optoelectronics SOLID STATE LAMPS ORANGE GREEN YELLOW HIGH EFFICIENCY RED MV5174B/C MV5274B/C MV5374B/C MV5774R/C

PRODUCT DESCRIPTION

These solid state indicators offer a variety of color selection. The orange and yellow devices are made with a gallium arsenide phosphide on gallium phosphide; the green units are made with gallium phosphide on gallium phosphide. The red units are made with gallium arsenide phosphide on gallium arsenide. All are encapsulated in epoxy packages. Their small size (approximately T-1 size), good viewing angle, and small square leads contribute to their versatility as all-purpose indicators.

PACKAGE DIMENSIONS



FEATURES

- High efficiency GaP light source with various lens effects
- See MV5074 series for additional red sources
- Versatile mounting on P.C. board or panel
- Long life—solid state reliability
- Low power requirements
- Compact, rugged, lightweight
- "B"—designated products have 0.6" (15.2 mm) minimum lead length
- "C"—designated products have 1" (25.4 mm) minimum lead length
- Square leads (will fit into .020" [.508 mm] diameter holes)
- Upon request, also available with anode lead trimmed longer than cathode

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	105 mW
Derate linearly from 25°C	1.14 mW/°C
Storage and operating temperatures	-55°C to 100°C
Lead solder time @ 260°C (See Note 2)	5 sec
Continuous forward current @ 25 C	
Continuous forward current @ 100°C	10 mA
Peak forward current (1 μ sec pulse, 0.3% duty cycle)	1.0 A
Reverse voltage	5.0.1/

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	PACKAGE PROFILE
MV5174B/C	Orange	Orange diffused	Wide beam	High profile
•	-	<u>-</u>		• •
MV5274B/C	Green	Green diffused	Wide beam	High profile
MV5374B/C	Yellow	Yellow diffused	Wide beam	High profile
MV5774B/C	Red	Red diffused	Wide beam	High profile

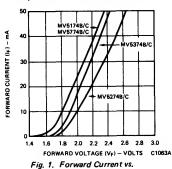
ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

PARAMETER	TEST COND.	UNITS	MV5174B/C	MV5274B/C	MV5374B/C	MV5774B/0
Forward voltage (V _F)						
Typ.	$I_F = 20 \text{ mA}$	V	2.0	2.2	2.1	2.0
Max.	I _F = 20 mA	V	3.0	3.0	3.0	3.0
Luminous intensity (see N	lote 1)*				_	
Min.	Í= = 20 mA	mcd	1.5	.4	1.5	1.5
Typ.	I _E = 20 mA	mcd	5.0	1.0	4.0	5.0
Peak wave length	I _F = 20 mA	nm	635	565	585	635
Spectral line Half width	I _F = 20 mA	nm	45	35	35	45
Capacitance Typ.	V = 0	pF	45	45	45	45
Reverse voltage (V _R)			_	-	5	5
Min.	$I_R = 100 \mu\text{A}$	V	5	5		25
Тур.	$I_R = 100 \mu\text{A}$	V	25	25	25	25
Reverse current (IR)		Λ_	00	20	20	20
Тур.	V _R = 5.0 V	nΑ	20		100	100
Max.	V _R = 5.0 V	μΑ	100	100		
Viewing angle (total)	See Fig. 3 & 4	degrees	90	90	90	90

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)



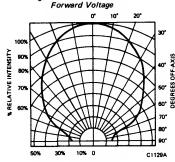


Fig. 3. Spatial Distribution

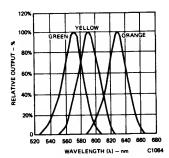


Fig. 2. Spectral Response

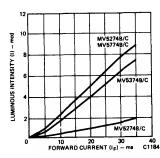


Fig. 4. Luminous Intensity vs. Forward Current

NOTES

- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

GENERAL INSTRUMENT Optoelectronics

SOLID STATE

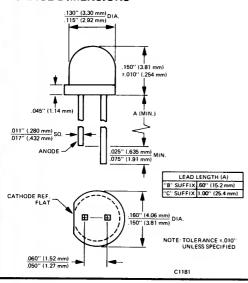
ORANGE GREEN YELLOW HIGH EFFECIENCY RED MV5777B/C

MV5177B/C MV5277B/C

PRODUCT DESCRIPTION

These solid state indicators offer a low profile T-1 package. The orange and yellow devices are made with gallium arsenide phosphide on gallium phosphide; the green units are made with gallium phosphide on gallium phosphide. The red units are made with gallium arsenide phosphide on gallium arsenide. All are encapsulated in epoxy packages. Their small size (approximately T-1 size), good viewing angle, and small square leads contribute to their versatility as all purpose indicators.

PACKAGE DIMENSIONS



FEATURES

Square leads (will fit into .020" [.508 mm] diameter hole)

- Compact size
- Bright (up to 3.0 mcd at 20 mA)
- Long life, rugged
- "B"-designated products have .6" (15.2 mm) minimum lead length
- "C"-designated products have 1" (25.4 mm) minimum lead length
- Mount on approximately 3/16" (4.72 mm) centers
- See MV5077 series for other red sources
- Upon request, also available with anode lead trimmed longer than cathode

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	15 mW
Derate linearly from 25°C	ıW/°C
Storage and operating temperatures	100°C
Continuous forward current @ 25°C	35 mA
Peak forward current (1 μ sec pulse width, 0.3% duty cycle)	1.0 A
Reverse voltage	5.0 V
Lead solder time @ 260°C (See Note 2)	E

PHYSICAL CHARACTERISTICS

TYPE	SOURCE COLOR	LENS COLOR	LENS EFFECT	PACKAGE PROFILE
MV5177B/C	Orange	Orange diffused	Wide beam	Low profile
MV5277B/C	Green	Green diffused	Wide beam	Low profile
MV5377B/C	Yellow	Yellow diffused	Wide beam	Low profile
MV5777B/C	Red	Red diffused	Wide beam	Low profile

ELECTRO-OPTICAL CH	IARACTERISTICS	(25°C Free	Air Temperatur	e)		
PARAMETER	TEST COND.	UNITS	MV5177B/C	MV5277B/C	MV5377B/C	MV5777B/C
Forward voltage (V _F)						2.0
Тур.	$I_F = 20 \text{ mA}$	V	2.0	2.2	2.1	_
Max.	I _F = 20 mA	V	3.0	3.0	3.0	3.0
Luminous intensity (see N	lote 1)*					
Min.	I _E = 20 mA	mcd	1.0	.2	1.0	1.0
Typ.	I _E = 20 mA	mcd	3.0	0.6	2.0	3.0
• •	I _F = 20 mA	nm	635	565	585	635
Peak wave length Spectral line	I _F = 20 mA	nm	45	35	35	45
Half width	1p 20					
Capacitance		_	4-	45	45	45
Тур.	V = 0	pF	45	45	45	43
Reverse voltage (V _R)			_	_	5	5
Min.	$I_R = 100 \mu\text{A}$	V	5	5_	-	
Тур.	$I_{\rm B} = 100 \mu A$	V	25	25	25	25
Viewing angle (total) (Fig		degrees	180	180	180	180
Dynamic resistance (R _D)	,,	Ω	7.0	7.0	7.0	7.0
*Luminous intensity guarant	eed to a 2.5% AQL inspe	ction plan per M	IIL-STD-105D.			

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

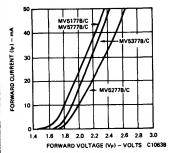


Fig. 1. Forward Current vs. Forward Voltage

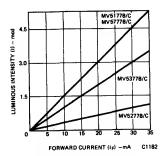


Fig. 2. Luminous Intensity vs. Forward Current

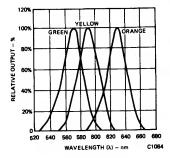


Fig. 3. Spectral Response

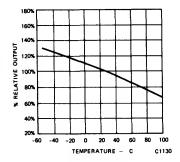


Fig. 4. Percent Relative Response vs. Temperature

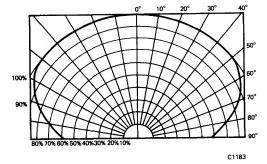


Fig. 5. Spatial Distribution

NOTES

- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The leads of the device were immersed in molten solder, at 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

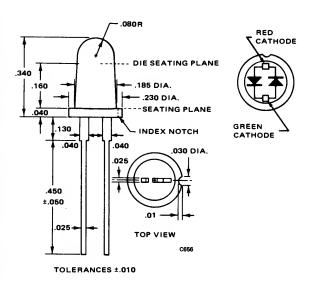
GENERAL INSTRUMENT Optoelectronics

MV5491 RED/GREEN TRI-STATE LAMP

PRODUCT DESCRIPTION

A green and red lamp made of GaAsP (Red) and GaP (Green) offering a changing color dependent on the direction the lamp is biased. These two light emitting diodes are mounted in the same convenient epoxy package.

PACKAGE DIMENSIONS



FEATURES

- Bright
- Long life, rugged
- True polarity indicating
- 3 states: Green, Red, Off
- Solid state
- Integrated circuit compatible
- Convenient mounting clip available
- Versatile mounting on P.C. board or panel

ABSOLUTE MAXIMUM RATINGS

Power Dissipation @ 25°C (Peak or Continuous)
Storage & Operating Temp
Currents
Red ON (Peak or Continuous, 25°C)
Green ON (Peak or Continuous, 25°C)
Derate linearly from 25°C
Red
Green
Lead solder time @ 260°C (See Note 3)

ELECTRO-OPTICAL CHARACTERISTICS (25°C Ambient Temperature)

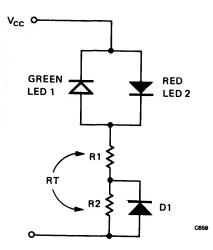
OPTICAL

	TYP.	MAX.	UNITS	CONDITIONS
Luminous Intensity (I) (note 2)				20 1
Red	1.5		mcd	I _F = 20 mA
Green	.5		mcd	$I_F = 20 \text{ mA}$
Wavelength (λpk)				
Red	660		nm	I _F = 20 mA
Green	560		nm	I _F = 20 mA
Spectral Half Width				
Red	20		nm	I _F = 20 mA
Green	30		nm	I _F = 20 mA
ELECTRICAL				
Forward Voltage (V _F)				
Red	1.65	2.0	volts	I _F = 20 mA
Green	2.2	3.0	volts	I _F = 30 mA
Dynamic Resistance (RD)				
Red	5.5		Ω	
Green	50.0		Ω	

THERM	AL CHAD	ACTEDISTICS

	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Forward Voltage Temp.					
Coefficient				\u00	20 0
Red		-1.5		mV/°C mV/°C	I _F = 20 mA
Green		-3.0		mV/°C	$I_F = 20 \text{ mA}$

$$D_1 = 1N914$$
 (or equivalent)



$$R_T = \frac{V_{CC} - V_{LED}}{I_{LED}}$$

$$R_{T} = \frac{V_{CC} - V_{LED2}}{I_{LED2}}$$
 $R_{1} = \frac{V_{CC} - (V_{LED1} + V_{D1})}{I_{LED1}}$

Example: Match Intensities of both red and green units at 20 mA and 35 mA respectively.

FOR RED:

FOR GREEN:

$$R_{T} = \frac{V_{CC} - V_{LED}}{I_{LED2}}$$

$$R_T = \frac{V_{CC} - V_{LED2}}{I_{LED2}}$$
 $R_1 = \frac{V_{CC} - (V_{LED1} + V_{D1})}{I_{LED1}}$

$$=\frac{5.0-1.63}{.020}$$

$$=\frac{5.0-(2.5+0.7)}{.035}$$

$$R_T - R_1 = R_2$$

$$168 - 51 = 117\Omega$$

SUGGESTED RESISTOR COMBINATIONS:

GREEN -		10 mA			20 mA			30 mA	
RED	R _T	R ₁	R ₂	R _T	R ₁	R ₂	R _T	R ₁	R ₂
10 mA	344	230	114	344	102	242	344	63	281
20 mA	170	230	-60	170	102	68	170	63	107
30 mA	112	230	-116	112	102	10	112	63	49
40 mA	84	230	-146	84	102	-18	84	63	21
50 mA	67	230	-163	67	102	-35	67	63	4
60 mA	55	230	-175	58	102	-47	55	63	-5
70 mA	47	230	-183	47	102	-55	47	63	-16

NOTES: 1) All values are in ohms

2) V_{CC} = 5 volts D.C.

3) Current combinations in shaded area not possible with circuit shown

Note: Values computed are for maximum currents through each diode.

TYPICAL ELECTRO-OPTICAL CHARACTERISTICS

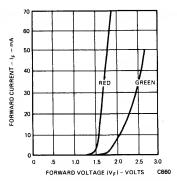


Fig. 1. Forward Current vs Forward Voltage

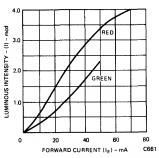


Fig. 2. Luminous Intensity vs Forward Current

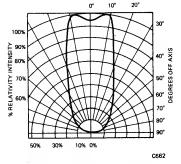


Fig. 3 Spatial Distribution (Note 1)

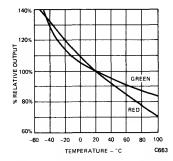


Fig. 4. Relative Output vs Temperature

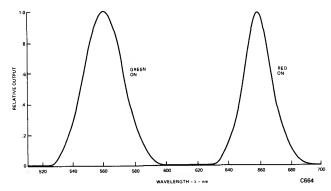


Fig. 5. Spectral Distribution

NOTES

- 1. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 2. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).

Children Control of the Control of t

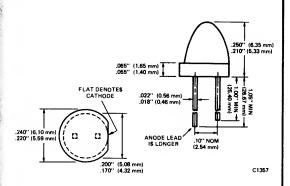
 The leads of the device were immersed in molten solder, heated to a temperature of 260°C to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds. GENERAL INSTRUMENT Optoelectronics

SOLID STATE LAMPS MV50152 MV53152 MV50154 MV53154 MV52152 MV57152 MV52154 MV57154

PRODUCT DESCRIPTION

These solid state indicators offer a variety of lens effects and color availability in a short barrel T-1-% package. The red, orange and yellow devices are made with gallium arsenide phosphide, and the green units are made with gallium phosphide. All are encapsulated in epoxy lenses.

PACKAGE DIMENSIONS



FEATURES

- Low cost
- High intansity light source with two lans effacts.
- Rad, orange, green and yallow colors available.
- Versatile mounting on P.C. board or panel.
- Long lifa—solid stata reliability
- Low power raquiraments
- Compact, rugged, lightwaight
- High efficiency
- Ultra high brightness
- Short T-1 3/4 siza

ABSOLUTE MAXIMUM RATINGS

Maximum power dissipation @ 25° C
ambient (rad)
Maximum power dissipation @ 25°C
ambient (Orange, yellow, green) 105 mV
Derate linearly from 25°C (GYO) 1,14 mW/°C
Derate linearly from 25°C (Rad) 2.0 mW/°C
Maximum storage and operating
tamperaturas55°C to 100°C

Maximum lead solder time @ 260°C (See Note 3) 5 Sec
Maximum currents and voltages
Continuous forward current
@ 25°C Red = 100 mA GYO = 35 mA
Continuous forward current @ 100°C 10 mA
Peak forward current (1 µS pulse,
0.3% duty cycle) 1.0 A
Reversa voltage

PHYSICAL CHARACTERISTICS

	SOURCE		
TYPE	COLOR	LENS COLOR	LENS EFFECT
MV50152	Rad	Red claar	Point source
MV50154	Red	Red lightly diffused	Soft point source
MV52152	Green	Green claar	Point sourca
MV52154	Green	Green lightly diffused	Soft point source
MV53152	Yellow	Yallow clear	Point source
MV53154	Yellow	Yellow lightly diffused	Soft point source
MV57152	Orange	Orange clear	Point source
MV57154	Orange	Orange lightly diffused	Soft point source

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

PARAMETER	TEST COND.	UNITS	MV50152	MV50154	MV52152	MV52154	MV53152	MV53154	MV57152	MV57154
Fwd, Voltage (V _F)	10 mA	V	1.6	1.6	2.2	2.2	2.1	2.1	2.0	2,0
Тур			1.6	1.6	2.2	2.2	2.1	2.1	2.0	2.0
Max			2.0	2.0	3.0	3.0	3.0	3.0	3.0	3,0
Luminous Intensity									4.0	2.0
(see Note 1) Min	10 mA	mcd	.6	.4	.75	.5	3.0	1.5	4.0	
Тур	10 mA	mcd	2.0	1.5	2.0	1.5	5.0	3.0	8.0	4.0
Peak wave length	10 mA	nm	660	660	565	565	58 5	58 5	630	630
Spectral line Half width	10 mA	nm	20	20	35	35	35	35	45	45
Capacitance Typ	V = 0	pF	30	30	45	45	45	45	45	45
Reverse volt, (V _R) Min	I _R = 100 μA	V	5	5	5	5	5	5	5	5
Typ			25	25	25	25	25	25	2 5	25
Reverse current (I _R)	V _R = 5.0 V	μA								
Max			100	100	100	100	100	100	100	100
Тур			20	20	20	20	20	20	20	20
Viewing angle										
(see fig. 3)			45	50	45	50	45	50	45	50

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

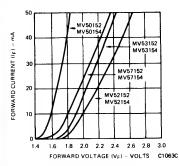


Fig. 1, Forward Current vs. Forward Voltage

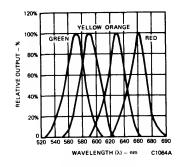


Fig. 2. Spectral Response

(25°C Free Air Temperature Unless Otherwise Specified)

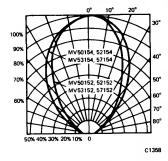


Fig. 3. Spatial Distribution (Note 2)

NOTES

- 1. As measured with a Photo Research Corp., "SPECTRA" Microcandela Meter (Model IV-D).
- 2. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 3. The leads of the device were immersed in molten solder at 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with a dwell time of 5 seconds.

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

GENERAL INSTRUMENT Optoelectronics

.220"
RECTANGULAR
LEGEND LAMP

GREEN YELLOW HI. EFF. RED MV52124 MV53124 MV57124

FEATURES

- .220" x .125" lighted area
- Stackable in X or Y direction
- High brightness—typically 3 mcd @ 20 mA
- Solid state reliability
- Compact, rugged, lightweight
- No light leakage from unit sides
- Mounting grommet available (see MP65)

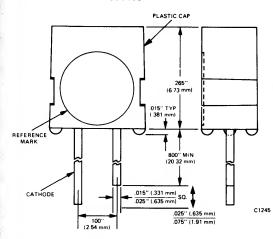
APPLICATIONS

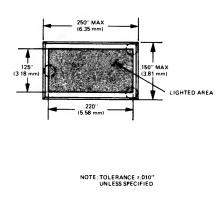
- Legend backlighting
- Illuminated pushbutton
- Panel indicator
- Bargraph meter

PRODUCT DESCRIPTION

This series of rectangularly shaped solid state indicators is available in green, yellow, and red. The rectangular lighted area is uniformly lit by a high performance LED chip.

PACKAGE DIMENSIONS





ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature)

PARAMETER	SYM	MV52124	MV53124	MV57124	UNITS	TEST CONDITIONS
Forward voltage, TYP.	VF	2.0	2.0	2.0	V	I _E = 20 mA
MAX.		3.0	3.0	3.0	V	
Luminous intensity, MIN.*	(See note 2)	1.0	1.0	1.0	mcd	I _E = 20 mA
TYP.		3.0	4.0	4.0	mcd	.,
Peak wavelength		565	585	635	nm	I _E = 20 mA
Spectral line half width		45	45	45	nm	I _F = 20 mA
Reverse voltage, MIN.	V _R	5	5	5	V	$I_{R} = 100 \mu A$
TYP.	• •	25	25	25	V	11
Reverse current, TYP.	I _B	20	20	20	nΑ	$V_{R} = 5.0 \text{ V}$
MAX.	**	100	100	100	μΑ	••
Capacitance		45	45	45	ρF	V = 0

^{*}Luminous intensity guaranteed to a 2.5% AQL inspection plan per MIL-STD-105D.

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C 105 mW Derate linearly from 25°C.....1.14 mW/°C Storage and operating temperature . .-55°C to 100°C Peak forward current 1 AMP (1 µsec pulse width, 300 pps)

Forward current @ 25°C... Lead solder time @ 260°C (See Note 1) . . . 5 seconds

MV52124

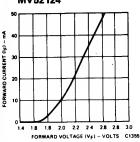


Fig. 1. Forward Current vs. Forward Voltage

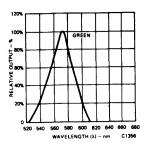


Fig. 2. Spectral Response

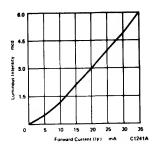


Fig. 3. Luminous Intensity vs. Forward Current

MV53124

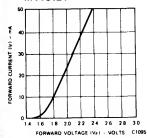


Fig. 4. Forward Current vs. Forward Voltage

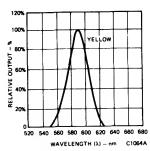


Fig. 5. Spectral Response

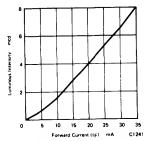


Fig. 6. Luminous Intensity vs. Forward Current

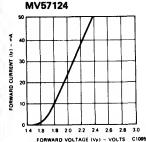


Fig. 7. Forward Current vs. Forward Voltage

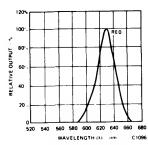


Fig. 8. Spectral Response

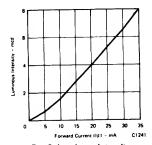


Fig. 9. Luminous Intensity vs. Forward Current

NOTES

- 1. The leads of the device were immersed in molten solder, heated to a temperature of 260°C, to a point 1/16 inch from the body of the device per MIL-S-750, with dwell time of 5 seconds.
- 2. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).

GENERAL INSTRUMENT Optoelectronics

HIGH EFFICIENCY RED MV57164 BAR GRAPH DISPLAY

FEATURES

- Large segments, closely spaced
- End stackable
- Fast switching, excellent for multiplexing
- Low power consumption
- Directly compatible with IC's
- Wide viewing angle
- Standard .3" DIP lead spacing
- Categorized for luminous intensity (see note 4)



DESCRIPTION

The MV57164 is a 10 segment bar graph display with separate anodes and cathodes for each light segment. The packages are end stackable.

ABSOLUTE MAXIMUM RATINGS

Power dissipation @25°C ambient	750 mW
Storage and operating temperature	14.3 mW/ C
Continuous forward current	
Total	300 mA
Per segment	30 mA
Reverse voltage	
Per segment	6.0 V
Solder time @260°C (see Note 3)	5 sec.

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance junction to free air $\Phi_{ extsf{JA}}$	160°C/W
Wavelength temperature coefficient (case temp)	1.0 A/°C
Forward voltage temperature coefficient	-2 0 m\//°C

FILTER RECOMMENDATIONS

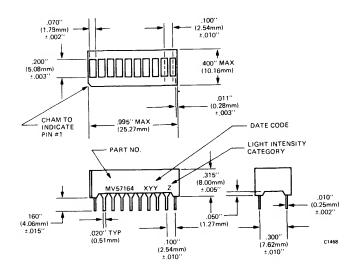
For optimum on and off contrast, one of the following filters or equivalents may be used over the display:

Panelgraphic Red 60 Homalite 100 – 1605

ECTRO-OPTICAL CHARACTERISTIC	IN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Forward Voltage			2.5	V	I _E = 10 mA
Luminous intensity (unit avg.) (see Note 1) 51	10			μcd	$I_F = 10 \text{ mA}$
Peak emission wavelength		630		nm	•
Spectral line half width		40		nm	
Dynamic resistance				_	
Segment		2 6		Ω	$I_F = 20 \text{ mA}$
Capacitance		35		рF	V = 0
Switching Time		400		nS	50 Ω system
	.0			V	$I_{R} = 100 \mu A$

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PACKAGE DIMENSIONS



PIN CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS	PIN NO.	ELECTRICAL CONNECTIONS	PIN NO.	ELECTRICAL CONNECTIONS		ELECTRICAL CONNECTIONS
1 2 3 4 5	Bar 1 Anode Bar 2 Anode Bar 3 Anode Bar 4 Anode Bar 5 Anode	6 7 8 9	Bar 6 Anode Bar 7 Anode Bar 8 Anode Bar 9 Anode Bar 10 Anode	11 12 13 14 15	Bar 10 Cathode Bar 9 Cathode Bar 8 Cathode Bar 7 Cathode Bar 6 Cathode	16 17 18 19 20	Bar 5 Cathode Bar 4 Cathode Bar 3 Cathode Bar 2 Cathode Bar 1 Cathode

TYPICAL CURVES (PER SEGMENT)

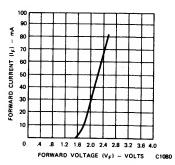


Fig. 1. Forward Current vs. Forward Voltage

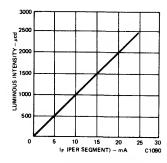


Fig. 2. Luminous Intensity vs. Forward Current

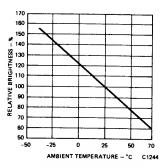


Fig. 3. Luminous Intensity vs. Temperature (See Note 2)

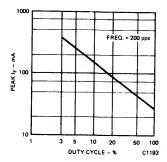


Fig. 4. Max Peak Current vs. **Duty Cycle**

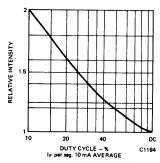
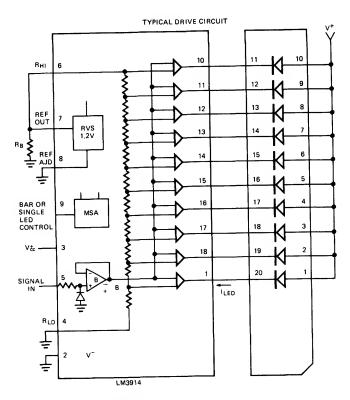


Fig. 5. Luminous Intensity vs. **Duty Cycle**



REFERENCE VOLTAGE SOURCE RVS: MODE SELECT AMPLIFIER

B: LED BRIGHTNESS CONTROL R_B:

BUFFER

C1471

NOTES

- 1. The average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. The standard of measurement is the Photo Research Corp. "Spectra" Microcandela Meter (Model IV-D) corrected for wavelength. Intensity will not vary more than ±33.3% between all segments within a unit.
- 2. The curve in Figure 5 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. Leads immersed to 1/16" from the body of the device. Maximum unit surface temperature is 140°C.
- 4. All units are categorized for luminous intensity. The invensity category is marked on each part as a suffix letter to the part number.
- 5. For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.

GENERAL INSTRUMENT Optoelectronics

HIGH EFFICIENCY RED MV57173 .5" RECTANGULAR LAMP

FEATURES

- .500" x .250" lighted area
- Solid state reliability
- Fast switching excellent for multiplexing
- Low power consumption
- Directly compatible with IC's
- Wide viewing angle
- .2" DIP lead spacing
- Mounting hardware available
- Categorized for luminous intensity (See note 1)



APPLICATIONS

- Panel indicators
- Backlight legends
- Light arrays

DESCRIPTION

The MV57173 is a large rectangular lamp which contains two LED chips with separate anodes and cathodes for each light. The illuminated area is 0.500 inches x 0.250 inches (12.7 mm x 6.35 mm).

Separate mounting hardware is available. See MP73.

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ABSOLUTE MAXIMUM RATINGS

Power Dissipation at 25°C	200
Derate linearly from 50°C.	200 mw
Storage Temperature40°C	3 mw/ C
Operating Temperature	to 100 C
Continuous Forward Current per light (75°C)	to +85°C
Continuous Forward Current per light (25°C).	. 35 mA
Cak Forward Current per LED Chip	1.0A
Solder Time at 260°C (See note 2)	E

TYPICAL THERMAL CHARACTERISTICS

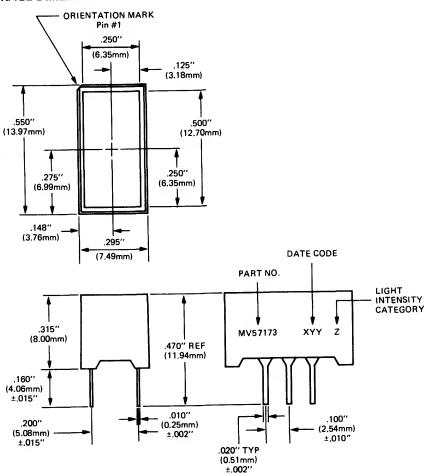
Thermal resistance junction to free air Φ_{JA} .	160°C/W
Wavelength temperature coefficient (case temp)	100 0/00
Forward voltage temperature coefficient	1.0 A/ C
-2	.0 mV/°C

FILTER RECOMMENDATIONS

For optimum on and off contrast, one of the following filters or equivalents may be used over the lamp:

Panelgraphic Red 60 Homalite 100-1605

PACKAGE DIMENSIONS



TOLERANCE ±.010" UNLESS SPECIFIED.

PIN CONNECTIONS

PIN NO.	ELECTRICAL CONNECTIONS
1	Cathode 1
2	No Pin
3	Anode 2
4	Cathode 2
5	NC
6	Anode 1



C1467

SCHEMATIC

ELECTRO-OPTICAL CHARACTERISTICS (Per LED Chip Unless Indicated)						
Forward Voltage Luminous Intensity (Total both LED chips on	SYM. V _F I	MIN. 4.5	TYP. 2.0	MAX. 2.5	UNITS V mcd	TEST CONDITIONS $I_F = 20 \text{ mA}$ $I_F = 20 \text{ mA}$ (per die
Peak Wavelength Spectral Line half width Reverse Voltage Capacitance Switching Time	VR	6	635 45 25 35 400		nm nm V pF nS	$I_F = 20 \text{ mA}$ $I_F = 20 \text{ mA}$ $I_R = 100 \mu\text{A}$ $V_F = 0$ 50 Ω system

TYPICAL CURVES (Per LED Chip Unless Indicated)

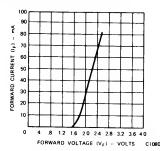


Fig. 1. Forward Current vs. Forward Voltage

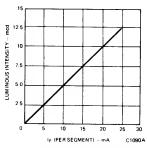


Fig. 2. Luminous Intensity vs. Forward Current (both LED chips on)

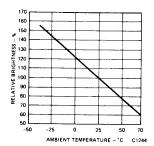


Fig. 3. Luminous Intensity vs. Temperature

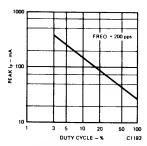


Fig. 4. Max Peak Current vs. **Duty Cycle**

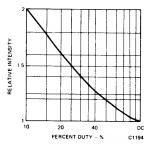


Fig. 5. Luminous Intensity vs. **Duty Cycle**

NOTES

- 1. All units are categorized for luminous intensity. The intensity category is marked on each part as a suffix letter to the part number.
- 2. Leads immersed to 1/16" from the body of the device. Maximum unit surface temperature is 140°C.
- 3. For flux removal, Freon TF, Freon TE, isoproponal or water may be used up to their boiling points.

GENERAL INSTRUMENT Optoelectronics

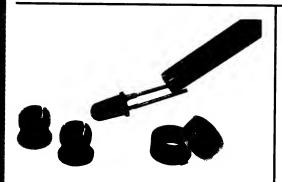
PANEL MOUNTING GROMMETS (FOR LED PANEL INDICATORS)

MP21 MP51 MP22 MP52

DESCRIPTION

The MP Series of mounting grommets is intended for panel mounting of many standard Monsanto light emitting diode indicators. The grommets are made of plastic and are available in clear and black.

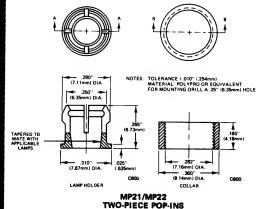
The MP Series will easily mount the applicable lamps on any panel thickness up to .125 inch (3.18mm).

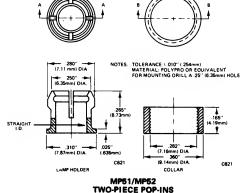


PANEL MAX .125" (3.18mm) C602

PART NUMBER	COLOR	AVAILABILITY	APPLICABLE LAMPS
MP21	CLEAR	Special order only	ME7021 thru ME7124;
MP22	BLACK	Standard	→ MV5020 thru MV5026
MP51	CLEAR	Special order only	MV5050 thru MV5056 MV5054-1-2-3
MP52	BLACK	Standard	MV5152 thru MV5752 MV5153 thru MV5753 MV5154 thru MV5754

DIMENSIONAL DATA





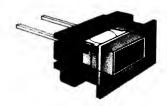
GENERAL INSTRUMENT Optoelectronics

MP65 PANEL MOUNTING GROMMET FOR .220" RECTANGULAR LAMP

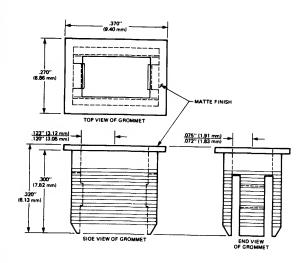
DESCRIPTION:

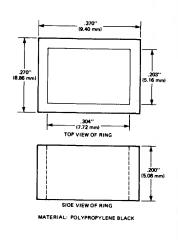
The MP65 mounting grommet is intended for panel mounting the MV5x124 series of rectangular lamps. The grommets are made of black plastic and provide the user with an easy-to-mount, professional appearance when viewed on a front panel.

The MP65 can be used on any panel thickness up to .125-inch (3.18 mm).



PACKAGE DIMENSIONS:





C1455

PANEL HOLE PUNCHING:

Punches can be ordered from one of the following sources:

W. A. WHITNEY COMPANY 650 Race Street Rockford, IL 61105

(Request a 28xx series punch with dimensions of 5/16" x 7/32")

(815) 964-6771 ROTEX PUNCH COMPANY, INC. 2350 Alvarado Street

(Request a 3506 series punch with dimensions of 5/16" x 7/32")

San Leandro, CA 94577 (415) 357-3600 Y .

GENERAL INSTRUMENT Optoelectronics

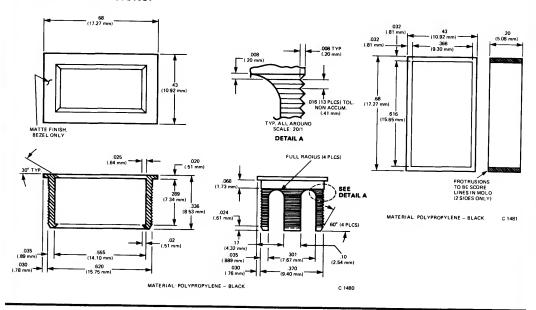
PANEL MOUNTING GROMMET FOR .500" RECTANGULAR LAMP

DESCRIPTION:

The MP73 mounting grommet is intended for panel mounting the MV57173 rectangular lamp. The grommets are made of black plastic and provide the user with an easy-to-mount, professional appearance when viewed on a front panel.

The MP73 can be used on any panel thickness up to .125-inch (3.18 mm).

PACKAGE DIMENSIONS:

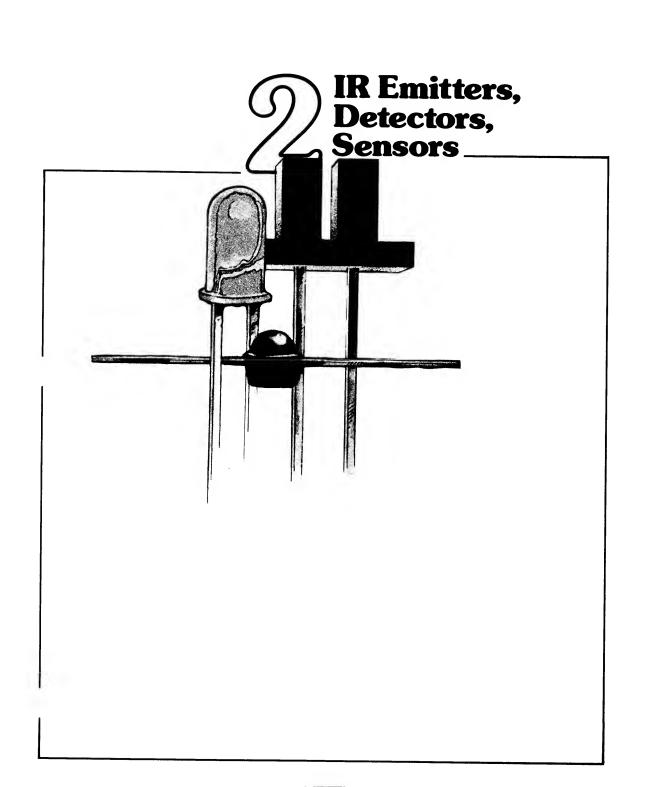


PANEL HOLE PUNCHING:

Punches may be ordered from one of the following sources:

W. A. WHITNEY COMPANY 650 Race Street Rockford, IL 61105 (815) 964-6771

ROTEX PUNCH COMPANY, INC. 2350 Alvarado Street San Leandro, CA 94577 (415) 357-3600



Sensors

					DELICTOR		MIN. CERRENT	
ACTI AT SIZE	DEVICE NO.	OUTPUT CONFIGURATION	I MILLER VOLTAGI	MIN BV(10)	TABICAL bili	MAX. V _{CT} (SAT)	TRANSLER RATIO	
S	MCT8	SLOTTED LIMIT SWITCH, TRANSISTOR				.4V @ 50μA .4V @ 25mA	1% 0.25%	
(half size)	MCA8	SLOTTED LIMIT SWITCH, DARLINGTON	1.5V @ 20m A	30V	-	1.0V @ 2mA 1.0V @ 1.6mA	12.5% 3.2%	
	MCA7	REFLECTIVE SENSOR, DARLINGTON	1.5V @ 20m A	30V	_	-	0.1%	

Emitters

ACT. SIZI	DI VICI	RADI ATLD POWLR	ON AMS IRRADIANCE OR INTENSITY	MAN. FORWARD A OLFAGI	MAN. DC CURRENT	MAX. POWLR	ON OLL DLLAY	APPLICATIONS
	ME60 ME61	550µW	250mW/cm ²	1.5V @ 50mA	50m A	75mW	10nsec	
	ME7021 ME7024	1.0mW	3.6mW/Str. 81.2mW/Str.	1.5V @ 20mA	100mA	150mW	100nsec	Card readers, en- coders, alarm and sector systems, level
	ME7121 ME7124	3.0mW	10.8mW/Str. 243.6mW/Str.	1.8V @ 50mA	100m A	150mW	500nsec	indicator, end-of- tape detection.
-	ME7161	3.0mW		1.8V @ 50mA	50mA	75mW	500nsec	

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MIN. DC ISOLATION VOLLAGI	BAND WIDTH	APPLICATIONS
	150KHz 200 KHz	Tage reader mark sensor and of two detection and of the
	0.8KHz	Tape reader, mark sensor, end-of-tape detector, end-of-film detector, metal processing equipment, length measurement, coded disk detection, edge sensor, textile processing equipment, fluid volume and velocity control, level detector, object sensor, strobing light control, stroboscope.
	1.5 KHz	
	0.8KHz	Object sensing, end-of-tape detection, length measurement, industrial processing equipment.

ACT. SIZE	DIAICI NO.	SINSHIVELY - V mW cin	335	MAN. DC CURRENI	MIN.	DARK CURRENI	BAND- WIDTH	APPLICATIONS
888	MT1	560	5V @ 2mA	40mA	30V	lnA		-11
888	МТ2	1400					300KHz	Optical switching, intrusion alarm, process
	MT8020	350	0.2V @ 1.6 mA	40mA	30V	1.5nA	-	control, tape and card reader, level controls, character recognition.

Detectors

GENERAL INSTRUMENT Optoelectronics

MCA7 REFLECTIVE OBJECT SENSOR

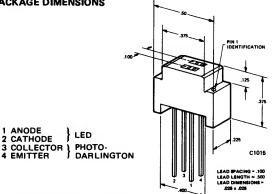
PRODUCT DESCRIPTION

The MCA7 opto-isolator consists of an infrared emitting diode and a silicon planar photo darlington. The on-axis radiation of the emitter and the on-axis response of the detector are both perpendicular to the face of the MCA7. The photodarlington responds to radiation emitted from the diode only when a reflective object or surface is in the field of view of the detector.

PACKAGE DIMENSIONS

PIN 1 ANODE 2 CATHODE

4 EMITTER



FEATURES

- High sensitivity
- Low Cost
- High reliability

APPLICATIONS

- Object sensing
- End-of-tape sensing

ALL DIMENSIONS ARE IN INCHES

LED

ABSOLUTE MAXIMUM RATINGS Storage Temperature-55°C to 100°C Operating Temperature -55°C to 100°C Lead Temperature (Soldering, 5 sec) 260°C Total Power Dissipation

INPUT DIODE

Power dissipation at 25°C ambient 90 mW
Derate Linearly from 25°C 1.2 mW/°C

Peak forward current (1 µs pulse, 300 pps). . 3.0 A

Collector to emitter voltage........... 30 V

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Tempereture Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE						
Forwerd Voltage	٧ _F		1.25	1.50	V	I _F = 20 mA
Reverse Breakdown Voltage	B∨ _R	3.0	5.5		V	IR = 10 μA
Junction Capacitance	cj		50		pF	VF= 0V
Reverse Leakage Current	lŔ		.01	10	μΑ	V _R = 3.0V
OUTPUT DARLINGTON						
Breakdown Voltage	BVCEO	30	55		V	Ic = 1.0 mA
	010					IF = 0 (NOTE 2)
Reverse Breakdown Voltage	BVECO	5	7		V	I _C = 100 μA
						IF = 0 (NOTE 2)
Leakage current	I _{CEO} (dark)		5	100	nA	V _{CF} = 5V (NOTE 2), I _F =0
Rise Time, Fall Time			0.6		mS	$V_{CE} = 5V, R_L = 1K\Omega$
COUPLED						
DC Current Transfer Ratio	(CTR)	.050	1		mA	I _E = 50 mA
						V _{CF} = 5.0V (NOTE 1 & 2)
						d = 1.0 CM

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (25° C Free Air Temperature Unless Otherwise Specified)

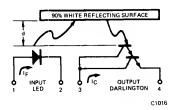


Figure 1 Parameter Symbols

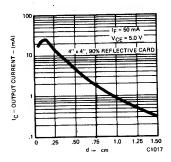


Figure 2 Output Current vs. Distance

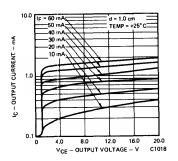


Figure 3 IC vs. VCE

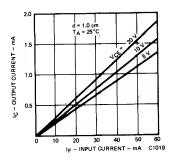


Figure 4 IC vs. IF

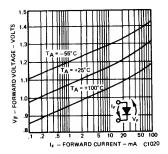


Figure 5 Forward Voltage vs. Forward Current

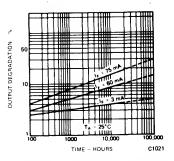
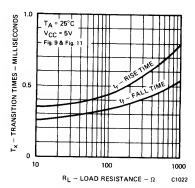


Figure 6 Lifetime vs. Forward Current



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Figure 7. Non-Saturated Rise and Fall Times vs. Load Resistance

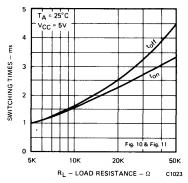


Figure 8. Saturated Switching Times vs. Load Resistance

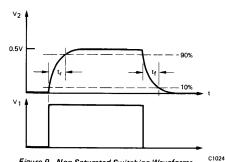
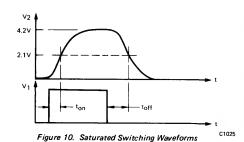


Figure 9. Non-Saturated Switching Waveforms



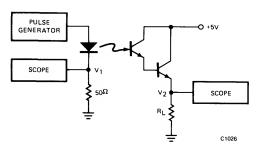


Figure 11. Circuit for Testing Switching Parameters

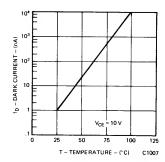
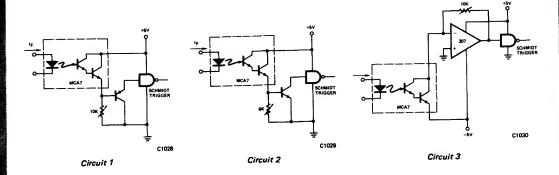


Figure 12. Dark Current vs. Temperature

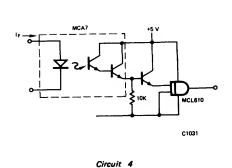
CIRCUITS TO INTERFACE THE MCA7 WITH 5V LOGIC



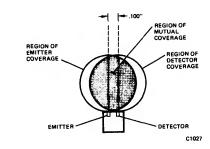
Normally High Output

Normally Low Output

Comparator Driver



Booster Drive to Logic Isolator



Spatial Distribution of Maximum Sensitivity

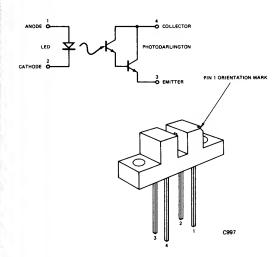
- 1. Photo current is obtained from a 4.0" x 4.0", 90% white surface placed at a distance of 1.0 cm from the surface of the MCA7.
- Measured with radiation flux intensity of lass than 0.1 μW/cm² (dark condition) over the spectrum from 0.1 micron to 1.5 microns.
- 3. Measured at typical factory ambiant of 150 foot-candles (150 lamberts par squara foot).

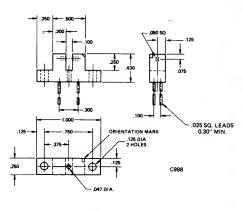
MCA8 MCA81 SLOTTED OPTICAL LIMIT SWITCH

PRODUCT DESCRIPTION

The MCA8 optical limit switch transmits light from a GaAs infrared emitting diode to a silicon photodarlington detector. Both semiconductor chips face each other across an .1-inch air gap. The MCA8 senses an object that interrupts the beam. Output current will directly operate a TTL Schmidt trigger.

PACKAGE DIMENSIONS





All dimensions are in inches.
Active area of LED is .014 x .014
Active area of PhotoDarlington is .010 x .020
Dimensions ± .010 inches

FEATURES

- High Sensitivity permits direct interface with TTL logic.
- Modular construction permits low cost package modification to suit any application.
- Recessed detector provides a high signal to noise ratio in ambient light.
- Plugs into standard DIP socket.
- Multiple flat reference surfaces allow precise mechanical alignment of the optical beam.
- Absence of lensing provides position sensitivity down to 0.020" between full on and full off.
- Solid copper lead-frame provides excellent heat sinking and highest reliability for the LED.
- One piece construction of the emitter and detector components provides excellent moisture resistance, immunity from thermal shocks, high and low temperature stability, and protection from shock and vibration.

APPLICATIONS

- Optical shaft position and velocity monitor using a digitally encoded disk mounted on a shaft.
- Optical sensing of holes in paper, paper tape, IBM card, or magnetic tape.
- Optical sensing of marks on paper, paper tape, or IBM card.
- End of tape sensor using a transparent section of tape, a reflective strip on the tape, or a hole in the tape.

- End of film sensor for films not affected by infra-red light.
- Limit switch for mechanical travel such as cam switches, pressure switches, machine tool limit switches, foot pedal switches, safety interlock switches.
- Edge sensor for sheet materials such as paper, plastic film, fabric, foil, newsprint, belt sanders, reproduction paper.
- Fiber continuity monitor for fibers such as yarn, wire, thread.
- Fluid volume monitor by sensing turbine vanes passing through the slot.
- Liquid level detector of an opaque liquid.

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIQUE	-					
Forward Voltage	VF		1.25	1.5	V	IF = 20 mA
Reverse Breakdown Voltage	B∨R	3,0	25		V	IR = 10 µA
Reverse Leakage Current	I _R		.01	10	μA	V _R = 3 V V _F = 0
Junction Capacitence			50		pF	VF-0
OUTPUT DARLINGTON-MCA8			2.2		.,	IC = 2 mA, IF = 16 mA (Nota 1)
Saturation Voltage	V _{CE} (SAT)		0.8	1.0	V V	IC = 1 mA, IF = 0 (Note 1)
Collector Breakdown Voltage	BVCEO	30	55		v	IC = 100 μA, IF = 0
Emitter Breekdown Voltage	BVECO	5	7		-	•
Dark CurrentMCA8	CEO		5	100	nΑ	VCE = 5.0 V, IF = 0 (Note-1)
Rise Time	tr		2.3		ms	$V_{CE} = 5 V, R_L = 1 K\Omega$
Fall Time	tf		1.7		ms	$V_{CE} = 5 V, R_L = 1 K\Omega$
Turn-on Time	tON		.3		ms	IF = 12 mA, FIG 12
Turn-off Time	tOFF		1.0		ms	I _F = 12 mA, FIG 12
DC Current Transfer Ratio	CTR	15	30		%	$I_F = 16 \text{ mA, V}_{CE} = 5 \text{ V}$
OUTPUT DARLINGTON-MCA81	0					
Saturation Voltage	V _{CE} (SAT)		0.8	1.0	V	I _C = 1.6 mA, I _F = 50 mA (Note 1)
Collector Breakdown Voltage	BVCEO	30	55		V	IC = 1 mA, IF = 0 (Note 1)
Emittar Braakdown Voltage	BVECO	5	7		V	IC = 100 μA, IF = 0
Dark Current	CEO		5	100	nA	V _{CE} = 5.0 V, I _F = 0 (Note 1)
Ambient Light Leakage Current	·CEO		2		μΑ	$V_{CE} = 5.0 \text{ V, I}_F = 0$
Rise Time	tr		.36		ms	$V_{CE} = 5 \text{ V}, \text{R}_{L} = 1 \text{ K}\Omega$
Fell Time	tf		.3		ms	$V_{CE} = 5 V, R_L = 1 K\Omega$
Turn-on Tima			.15		ms	I _F = 40 mA, FIG 12
	ton		.2		ms	I _F = 40 mA, FIG 12
Turn-off Time	^t OFF CTR	4	8		%	IF = 16 mA, V _{CE} = 5 V
DC Current Transfer Ratio	CIR	•	-			

ABSOLUTE MAXIMUM RATINGS

Storage Temperature Range -65° C to $+100^{\circ}$ C Operating Temperature Range -55° C to $+100^{\circ}$ C Lead Temp. (Soldering, 10sec) 260° C Total Power Diss. @ 25° C Free Air Temperature
Derate Linearly to 100° C (θ_{JA}) 1.65 mW/ $^{\circ}$ C Input to Output Isolation Voltage 1500 VAC

Input Diode
Power Dissipation @25°C Ambient 90 mW
Power Dissipation @25°C Ambient 90 mW Derate Linearly from 25°C 1.2 mW/°C
Forward Current 60 mA
Reverse Voltage 3 V
Peak Forward Current
(1 μs pulse, 300 pps)
Output Darlington
Collector-Emitter Voltage (BV _{CEO}) 30 V
Collector Current 100 mA

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

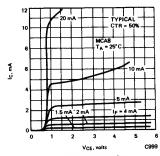


Figure 1 Collector Current vs. Collector Voltage

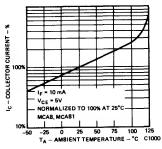


Figure 2 Collector Current vs. Ambient Temperature

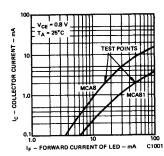


Figure 3 Collector Current vs. LED Current

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (CONT.) VF - FORWARD VOLTAGE - VOLTS VCE(SAT) - SATURATION VOLTAGE OUTPUT DEGRADATION 1111 IF = 16 mA I_C = 2 mA TA - AMBIENT TEMPERATURE - °C C1002 TIME - HOURS C1004 Figure 4 Saturation Voltage Figure 5 Forward Voltage Figure 6 Lifetime vs. vs. Tempereture vs. Forward Current Forward Current 104 r - Transition times - MILLISECONDS TA = 25°C V_{CC} = 5V 10 ID - DARK CURRENT - (nA) 10 V Fig. 10 & Fig. 11 10 100 5K 20K 50 125 R_L - LOAD RESISTANCE - Ω C1005 R_L - LOAD RESISTANCE + Ω C1008 T - TEMPERATURE - (°C) Figure 7 Non-Satureted Rise and Fell Times Figure 8 Saturated Switching Times Figure 9. Derk Current vs. Load Resistance vs. Load Resistence vs. Tempereture ٧2 ٧2 0.5V 4.2V 2.1V 10% ٧1 ٧1 C1008 C1009 Figure 10 Non-Satureted Switching Weveforms Figure 11 Saturated Switching Weveforms PW = 10-100 msec DC = 10% PULSE -O +5V $t_r t_f = \leq 10 \text{ nsec}$ GENERATOR SCOPE 50Ω ٧2 SCOPE RL S C1010

Figure 12 Circuit for Testing Switching Parameters

Figure 12 Driving a TTL Schmidt Trigger

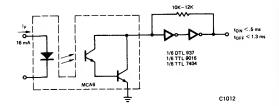


Figure 13 Driving Two Hex Inverters

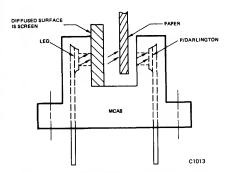


Figure 14 Detecting Paper by using a Lens Screen

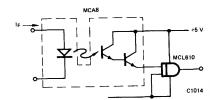


Figure 15 TTL Logic Interface

NOTES:

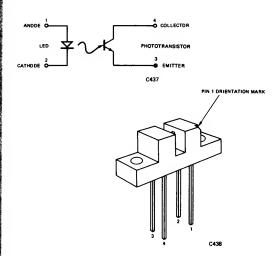
1. Measured with radiation flux intensity of less than 0.1 μW/cm² (dark condition) over the spectrum from 0.1 micron to 1.5 microns.

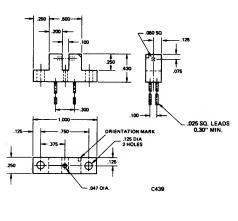
MCT8 MCT81 SLOTTED OPTICAL LIMIT SWITCH

PRODUCT DESCRIPTION

The MCT8 optical limit switch transmits light from a GaAs infrared emitting diode to a silicon phototransistor. Both semiconductor chips face each other across an .1-inch air gap. The MCT8 senses an object in the air gap by the effect on light transmission.

PACKAGE DIMENSIONS





Dimensions ± .010 inches
All dimensions are in inches.

FEATURES

- Transistor detector allows faster switching speeds than darlington detector.
- Modular package design permits low cost package modification to suit any application.
- Recessed detector and use of black plastic provide a high signal to noise ratio in ambient light.
- Plugs into standard DIP socket.
- Solid copper lead-frames provide excellent heat sinking.

APPLICATIONS

- Optical shaft position and velocity monitor using a digitally encoded disc mounted on a shaft.
- Optical sensing of holes in paper, paper tape, IBM card, or magnetic tape.
- Optical sensing of marks on paper, paper tape, or IBM card.
- End of tape sensor using a transparent section of tape, a reflective strip on the tape, or a hole in the tape.
- End of film sensor for films not affected by infra-red light.
- Limit switch for mechanical travel such as cam switches, pressure switches, machine tool limit switches, foot pedal switches, safety interlock switches.
- Edge sensor for sheet materials such as paper, plastic film, fabric, foil, newsprint, belt sanders, reproduction paper.
- Fiber continuity monitor for fibers such as yarn, wire, thread.
- Fluid volume monitor by sensing turbine vanes passing through the slot.
- Liquid level detector of an opaque liquid.

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE Forward Voltage Reverse Breakdown Voltage Reverse Leakage Current	V _F BV _R I _R	3.0	1.30 20 .01	1.50 10	∨ ∨ μA	$I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_R = 3 \text{ V}$
OUTPUT TRANSISTOR—MCT8 DC Current Transfer Ratio Saturation Voltage Collector Breakdown Voltage Emitter Breakdown Voltage Dark Current Rise Time Fall Time Turn-on Time (from 5 V to 0.8 V) Turn-off Time	CTR VCE(SAT) BVCE0 BVEC0 ICE0 tr tf ton	.200 30 5	1.0 0.2 55 7 5 5 4	0.4	mA V V NA μsec μsec μsec μsec	$\begin{split} &I_{F} = 20 \text{ mA, } V_{CE} = 10 \text{ V} \\ &I_{C} = 50 \mu\text{A, } I_{F} = 20 \text{ mA (Note 1)} \\ &I_{C} = 1 \text{ mA, } I_{F} = 0 \text{ (Note 1)} \\ &I_{C} = 100 \mu\text{A, } I_{F} = 0 \text{ (Note 1)} \\ &V_{CE} = 10.0 V, I_{F} = 0 \text{ (Note 1)} \\ &V_{CC} = 10 V, I_{C} = 1 \text{ mA} \\ &R_{L} = 100 \Omega \text{ CIRCUIT 1} \\ &V_{CC} = 10 V, I_{C} = 1 \text{ mA, } \\ &R_{L} = 100 \Omega \text{ CIRCUIT 1} \\ &I_{F} = 40 \text{mA CIRCUIT 2} \\ &R_{B} = 1.2 k\Omega, R_{L} = 2.4 k\Omega \\ &I_{F} = 40 \text{mA CIRCUIT 2} \end{split}$
Turn-off Time (from SAT. to 2 V) OUTPUT TRANSISTOR—MCT81 DC Current Transfer Ratio Saturation Voltage Collector Breakdown Voltage Emitter Breakdown Voltage Dark Current Ambient Light Leakage Current Rise Time Fall Time Turn-on Time (from 5 V to 0.8 V) Turn-off Time (from SAT to 2 V)	CTR VCE (SAT) BVCEO BVECO ICEO tr tf ton	50 30 5	100 0.2 55 7 5 0.30 3 4 6	0.4	μΑ V V nA μA μsec μsec	$\begin{split} & I_F = 40 \text{ mA CIRCUIT 2} \\ & R_B = 1.2 k \Omega, \ R_L = 2.4 k \Omega \\ \\ & I_F = 20 \text{ mA, } V_{CE} = 10 \text{ V} \\ & I_C = 25 \mu\text{A, } I_F = 20 \text{ mA (Note 1)} \\ & I_C = 1 \text{mA, } I_F = 0 \text{ (Note 1)} \\ & I_C = 100 \mu\text{A, } I_F = 0 \\ & V_{CE} = 10.0 \text{V, } I_F = 0 \text{ (Note 1)} \\ & V_{CE} = 10.0 \text{V, } I_C = 1 \text{mA} \\ & R_L = 100 \Omega \text{CIRCUIT 1} \\ & V_{CC} = 10 \text{V, } I_C = 1 \text{mA} \\ & R_L = 100 \Omega \text{CIRCUIT 1} \\ & I_F = 40 \text{mA CIRCUIT 2} \\ & R_B = 1.2 k \Omega, \ R_L = 2.4 k \Omega \\ & I_F = 40 \text{mA CIRCUIT 2} \\ & R_B = 1.2 k \Omega, \ R_L = 2.4 k \Omega \end{split}$

ABSOLUTE MAXIMUM RATINGS

Storage Temperature Range65°C to +100°C
Operating Temperature Range55°C to +100°C
Lead Temp. (Soldering, 10 sec) 260°C
Total Power Diss. @ 25°C Free
Air Temperature 275 mW
Derate Linearly to 100° C (θ_{JA}) 3.7 mW/ $^{\circ}$ C

Input Diode Power Dissipation @ 25° C Ambient90 mW Derate Linearly Above 25° C 1.2 mW/° C Forward Current 60 mA Reverse Voltage 3 V	
Peak Forward Current (1 μs pulse, 300 pps) 3.0 A	
Output Transistor Collector-Emitter Voltage	

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

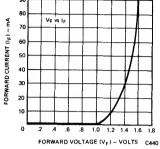


Fig. 1. Forward Voltage vs. Forward Current

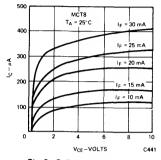


Fig. 2. Collector Current vs. Collector Voltage

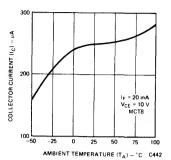


Fig. 3. Collector Current vs. Ambient Temperature

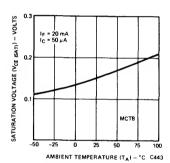


Fig. 4. Saturation Voltage vs. Temperature

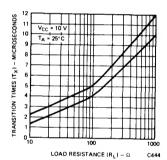


Fig. 5. Non-saturated Rise and Fall Times vs. Load Resistance

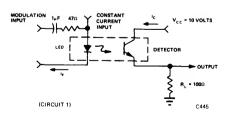


Figure 6.

The same to be a second

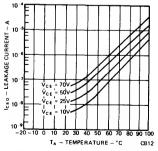
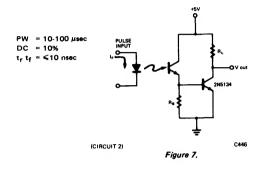


Fig. 7. Dark Current vs. Temperature

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (CONT.)



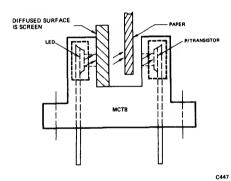


Fig. 8. Detecting Paper by Using a Lens Screen

NOTES:

1. Measured with radiation flux intensity of less than 0.1 μW/cm² (dark condition) over the spectrum from 0.1 micron to 1.5 microns.

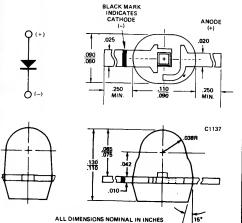
ME60 INFRARED EMITTER

PRODUCT DESCRIPTION

The ME60 is a diffused planar gallium arsenide infrared diode. The lead-frame construction is encapsulated in an epoxy case and lens.

PACKAGE DIMENSIONS

The state of the s



FEATURES

The ME60 is intended for high volume infrared source application where low cost, high reliability and high density packaging are required.

- Low Cost
- Compatible with integrated circuits
- Long life, rugged
- Small Size
- Easily assembled in linear arrays
- Card & tape reader sources
- High on-axis power

ABSOLUTE MAXIMUM RATINGS

TOLERANCES · 010

Power dissipation @ 25°C ambient
Derate intearly from 25 C
Lead solder time @ 230°C (See Note 1)
FO m A
Peak forward current (1 μsec pulse width, 0.3% duty cycle)
Reverse voltage

C684

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified) TEST CHARACTERISTICS MIN TYP. MAX. UNITS CONDITIONS Total external radiated power (see note 2) 400 550 μW IF = 50 mA On-axis irradiance 250 μW/cm² $I_F = 50 \text{ mA}, d = 1 \text{ cm}$ Peak emission wave length 900 nm Spectral line half-width 50 nm Forward voltage 1.3 1.5 V IF = 50 mA Reverse current 5 $V_R = 3.0 \text{ volts}$ nΑ Light turn-on and turn-off 10 ns Capacitance 80 рF V=0 Reverse breakdown voltage 3 5 $I_R = 10 \mu A$ Forward voltage temperature coefficient mV/°C -1.05 $I_F = 10 \text{ mA}$

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

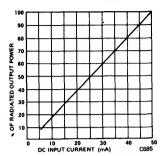


Fig. 1. Input Current vs. Output Power

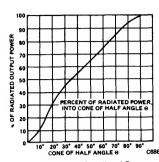


Fig. 2. Percent of Redieted Power into Cone of Half Angle

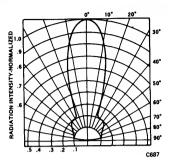


Fig. 3. Spatial Distribution (Note 3)

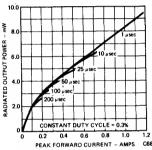


Fig. 4. Rediated Output Power vs. Peak Forward Current

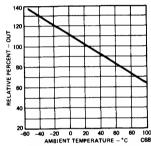


Fig. 5. % Relative Output vs. Temperature

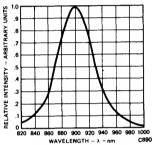


Fig. 6. Spectrel Distribution

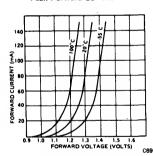


Fig. 7 Forward Current vs. Forward Voltege

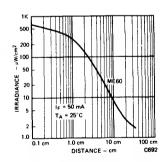


Fig. 8. On-Axis Irradience vs. Distance (Note 4)

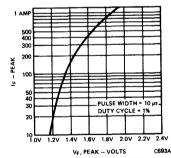


Fig. 9. V_F vs. I_F (to 4 A) Pulsed

- 1. The leads of the device were immersed in molten solder, heated to a temperature of 230°C, to a point 1/16 inch from the body of the device per MIL-S-750.
- 2. The total external radiated power output measurements are made with a Centralab 110C solar cell terminated into a 100Ω impedance.
- 3. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.
- 4. Distance measurements taken from top of lens.

ME61 INFRARED EMITTER

PRODUCT DESCRIPTION

The ME61 is a diffused planar gallium arsenide infrared diode. The lead-frame construction is encapsulated in an epoxy case and lens and provides an alignment stud as an integral part of the package.

FEATURES

The ME61 is intended for high volume infrared source application where low cost, high reliability and high density packaging are required.

- Stud base for precise alignment
- Low Cost
- · Compatible with integrated circuits
- Long life, rugged
- Small Size
- Easily assembled in linear arrays
- Card & tape reader sources
- High on-axis power

ABSOLUTE MAXIMUM RATINGS

怨

Power dissipation @ 25°C ambient			 75 m
Derate linearly from 25°C			 1.0 mW/°
SIOFAGE AND ODERATING TEMPERATURE			CC C . 100°
Lead solder time @ 230°C (See Note 1)			
o o war a current			 50 m
Peak forward current (1 μ sec pulse widt	h, 0.3% duty	cycle)	
Reverse voltage			 3.0

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

C694

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CHARACTERISTICS
Total external radiated power (see note 2)	400	550		μW	I _E = 50 mA
On-axis irradiance		250		μW/cm²	I _E = 50 mA, d = 1 cm
Zone 1 power (see Fig. 7)	45			μW	I _E = 50 mA
Peak emission wavelength		900		nm	.,
Spectral line half-width		50		nm	
Forward voltage		1.3	1.5	V	I _F = 50 mA
Reverse current		5		nA	$V_{\rm p} = 3.0 \text{ volts}$
Light turn-on and turn-off		10		ns	R old folia
Capacitance		80		pF	V = 0
Reverse breakdown voltage	3	5		V	Ι _Ρ = 10 μΑ
Forward voltage temperature coefficient		-1.05		mV/°C	L = 10 mΔ

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

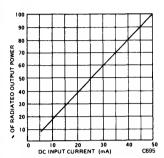


Fig. 1. Input Current vs. Output Power

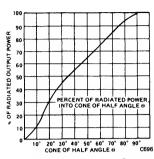


Fig. 2. Percent of Radiated Power into Cone of Half Angle

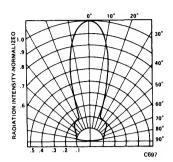


Fig. 3. Spatial Distribution (Note 3)

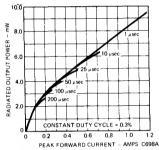


Fig. 4. Radiated Output Power vs. Peak Forward Current

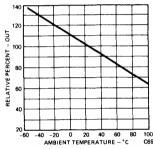


Fig. 5. % Relative Output vs. Temperature

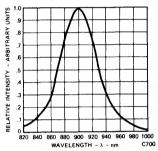


Fig. 6. Spectral Distribution

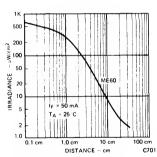


Fig. 7. On-Axis Irradiance vs. Distance

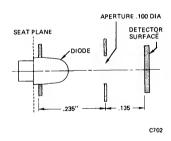


Fig. 8. Zone 1 Measurement

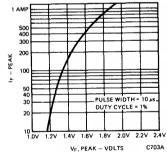


Fig. 9. VF vs. IF (to 4A) Pulsed

- 1. The leads of the device were immersed in molten solder, heated to a temperature of 230°C, to a point 1/16 inch from the body of the device per MIL-S-750.
- 2. The total external radiated power output measurements are made with a Centralab 110C solar cell terminated into a 100 Ω impedance.
- 3. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.

ME7021 ME7024 INFRARED EMITTERS

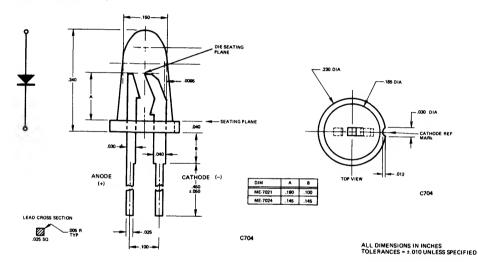
into cone @ 1/2 power points

{ @ I_F = 50 mA ROP = 1 mW

PRODUCT DESCRIPTION

This family of IR Emitters is designed to accommodate all needs of the emitter detector relationship. Products range from a wide angle power spread for non-critical detector location to sharp-angle concentration of power for detectors located a significant distance from the emitter. The devices can be mounted with a plastic pop-in, furnished upon request.

PACKAGE DIMENSIONS



ELECTRO-OPTICAL CHARACTERISTICS

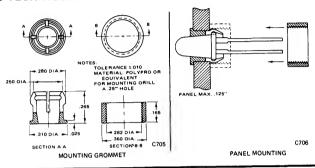
	TYPICAL HALF ANGLE (DEGREES)	TYPICAL ON AXIS INTENSITY (MW/STR.) @ 50 mA
ME7021	15°	3.6
ME7024	4°	81.2

	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
Total External Output Power (Note 2)	.5	1.0		mW	I _F = 50 mA
Peak Emission Wave Length		900		nm	I _F = 50 mA
Spectral Line Half Width		50		nm	I _F = 50 mA
Forward Voltage		1.3	1.5	V	I _F = 50 mA
Reverse Breakdown Voltage	5.0	8.0		V	$I_{\rm P} = 100 \mu A$
Capacitance		105		pF	V=0, f=1 MHz
Light Turn On & Turn Off Time		100		nsec	50 Ω Load
Dynamic Resistance (RD)		1.6		Ω	$T_{-} = 100 \text{ mA}$

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient
Derate linearly from 50°C
Storage & operating temperature
Lead solder time @ 230 (INOTE 3)
Continuous forward current
Poverse veltage
Peak forward current (PW - 1.0 µsec, Duty Cycle = 0.3%)

PANEL MOUNTING TECHNIQUES



TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free air temperature unless otherwise specified)

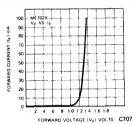


Fig. 1. IF vs. VF

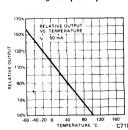


Fig. 4. ROP vs. Temperature (Note 1)

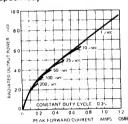


Fig. 2. ROP vs I F Peak

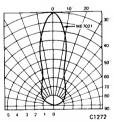


Fig. 5. Spatial Distribution (ME7021)

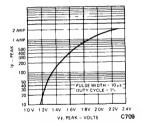


Fig. 3. IF Peak Pulse Mode Characteristics

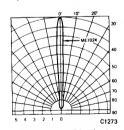


Fig. 6. Spatial Distribution (ME7024)

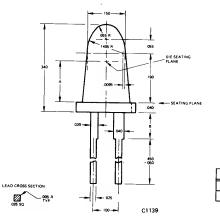
- The curves in figure 3 are normalized to the power output at 25°C to indicate the relative efficiency over the operating temperature range.
- 2. The total external radiated power output measurements are made with a Centralab 110C solar cell terminated into a 100\Omega impedance.
- 3. The leads of the ME7021 and ME7024 were immersed in molten solder, heated to 230°C, to a point 1/16 inch from the body of the device, per MIL-S-750.

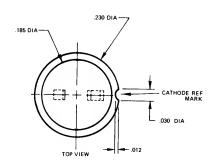
ME7121 ME7124 HIGH POWER INFRARED EMITTERS

PRODUCT DESCRIPTION

This family of high power liquid phase epitaxial IR Emitters is designed to accommodate all needs of the emitter detector relationship. Products range from a wide angle power spread for non-critical detector location to sharp-angle concentration of power for detectors located a significant distance from the emitter. The devices can be mounted with a plastic pop-in, furnished upon request.

PACKAGE DIMENSIONS





C1140

DIM	Α	8
ME7121	.190	.100
ME 7124	.145	.145

ALL DIMENSIONS IN INCHES TOLERANCES = ±.010 UNLESS SPECIFIED

V_R = 3.0 V

ABSOLUTE MAXIMUM RATINGS

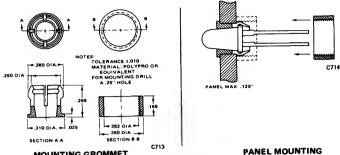
Power dissipation @ 25°C ambient	150 mW
Derate linearly from 50°C	mW/°C
Derate linearly from 50° C	100°C
Load solder time @ 250 C (140te 3)	5 500
Continuous forward current	100 m A
Reverse voitage	201/
Peak forward current (PW = 1.0 μsec, Duty Cycle = 0.3%)	. 3.0 V

ELECTRO-OPTICAL CHARACTERISTICS

《编集》 第二次,在1965年代,196

1	TYPICAL HALF ANGLE (DEGREES)		TYPICAL ON AXIS INTENSITY (MW/STR.) @ 50 mA		
ME7121 ME7124	17° 6°		10.8 243.6	{	into cone @ 1/2 power points @ I _F = 50 mA ROP = 3 mW
	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Total External Output Power (Note 2 Peak Emission Wavelength Spectral Line Half Width	1.0	3.0 940 50		mW nm nm	I _F = 50 mA I _F = 50 mA I _F = 50 mA
Forward Voltage Light Turn On & Turn Off Time Reverse Current		1.4 500 10	1.8	V nsec μΑ	$I_F = 50 \text{ mA}$ $50 \Omega \text{ Load}$ $V_B = 3.0 \text{ V}$

PANEL MOUNTING **TECHNIQUES**



MOUNTING GROMMET

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free air temperature unless otherwise specified.)

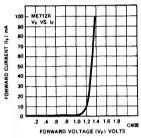


Fig. 1. IF vs. VF

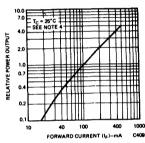


Fig. 2. ROP vs. I F Peak

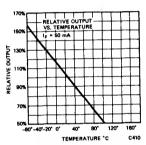


Fig. 3. ROP vs. Temperature (Note 1)

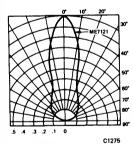


Fig. 4. Spatial Distribution (ME7121)

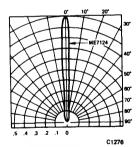


Fig. 5. Spatial Distribution (ME7124)

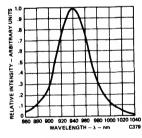


Fig. 6. Spectral Distribution

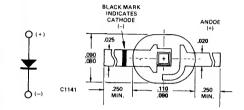
- 1. The curves in figure 3 are normalized to the power output at 25°C to indicate the relative efficiency over the operating temperature range.
- 2. The total external radiated power output measurements are made with a Centralab 110C solar cell terminated into a 100 Ω impedance.
- 3. The leads of the ME7121 and ME7124 were immersed in molten solder, heated to 230°C, to a point 1/16 inch from the body of the device, per MIL-S-750.
- This parameter is measured using pulse techniques pw = 40 μsec duty cycle ≤10%.

ME7161 INFRARED EMITTER

PRODUCT DESCRIPTION

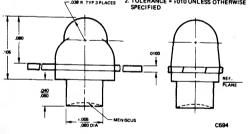
The ME7161 is a liquid phase epitaxial gallium arsenide infrared diode. The lead-frame construction is encapsulated in an epoxy case and lens.

PACKAGE DIMENSIONS



NOTE:

- 1. CENTERLINE OF STUD TO CENTERLINE OF LENS TIR ±.010 2. TOLERANCE = ±010 UNLESS OTHERWISE SPECIFIED



FEATURES

The ME7161 is intended for high volume infrared source application where low cost, high reliability and high density packaging are required.

- Low cost
- Compatible with integrated circuits
- Long life, rugged
- Small size
- Easily assembled in linear arrays
- Card & tape reader sources
- High on-axis power

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	
Derate linearly from 25°C	/5 m/W
Storage & operating temperature	mW/ຼັC
Lead solder time @ 230°C (See Note 1)	100°C
Continuous forward current	. 5 sec
, san total deduction of mose build with the same and the	
Reverse voltage	3.0 V

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Total external radiated power (see Note 2)	0.8	3.0		\ 44	
Peak emission wave length	•••			mW	$I_F = 50 \text{ mA}$
Spectral line half-width		940		nm	$I_F = 50 \text{ mA}$
		50		nm	$I_F = 50 \text{ mA}$
Forward voltage		1.3	1.8	V	
Reverse current			1.0	=	I _F = 50 mA
Light turn-on and turn-off		10		μΑ	V _R = 3.0 ∨
		50 0		ns	50Ω Load
Capacitance		80		pF	V = 0
Forward voltage temperature coefficient		-1.05		mV/°C	l = 10 mΔ

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

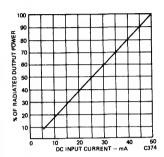


Fig. 1. Input Current vs. **Output Power**

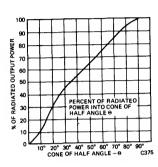


Fig. 2. Percent of Radiated Power Into Cone of Half Angle

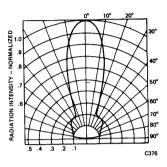


Fig. 3. Spatial Distribution (Note 3)

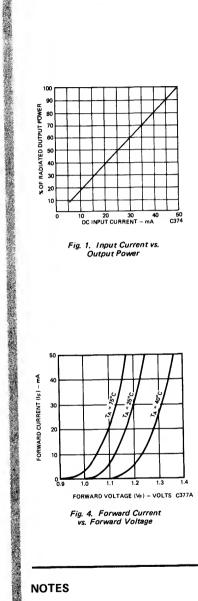


Fig. 4. Forward Current vs. Forward Voltage

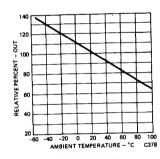


Fig. 5. % Relative Output vs. Temperature

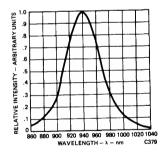


Fig. 6. Spectral Distribution

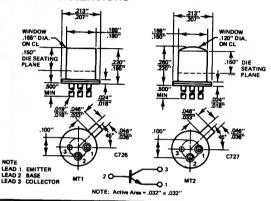
- 1. The leads of the device were immersed in molten solder, heated to a temperature of 230° C, to a point 1/16 inch from the body of the device per MIL-S-750.
- 2. The total external radiated power output measurements are made with a Centralab 110C solar cell terminated into a 100Ω impedance.
- 3. The axis of spatial distribution are typically within a 10° cone with reference to the central axis of the device.

SILICON PHOTOTRANSISTOR

PRODUCT DESCRIPTION

The MT1 and MT2 silicon phototransistors are mounted on a standard TO46 header. The MT1 features a flat window mounted at the top of a protective metal can. The MT2 has a lens in the same position for an optical gain of 4.

PACKAGE DIMENSIONS



FEATURES & APPLICATIONS

- Low leakage current 1 nA
- Wide Spectral Response
- Responsive to GaAs 1.40 mA/mW/cm²
- Optional flat lens (MT1) or built-in optics (MT2)
- Standard Transistor (Hermetic Seal) package for easy handling and mounting
- Optical switching & encoding
- Intrusion Alarm
- **Process Control**
- Tape and Card Reader
- Level & Industrial Control
- Optical Character Recognition

ABSOLUTE MAXIMUM RATINGS

Storage and Operating Temperature -55°C to 125°C Maximum Lead Solder Time @ 260°C (See Note 1) - 7.0 sec 200 mW Collector-Emitter Breakdown Voltage (BV_{CEO}) 2.0 mW/°C Emitter-Collector Breakdown Voltage (BV_{ECO}) 30 V

ELECTRO-OPTICAL CHARACTERISTICS

(25° C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTICS & SYMBOLS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Sensitivity MT1 (see note 3) (S _{CEO}) Sensitivity MT2 (see note 3) (S _{CEO}) Sensitivity MT1 (see note 4) (S _{CEO}) Sensitivity MT1 (see note 4) (S _{CEO}) Sensitivity MT1 (see note 3) (S _{CBO}) Sensitivity MT1 (see note 3) (S _{CBO}) Sensitivity MT1 (see note 4) (S _{CBO}) Sensitivity MT1 (see note 4) (S _{CBO}) Collector-emitter saturation voltage (V _{CE} (sat)) Light current fall time (see figure 8) (t _r) Delay time (see figure 8) (t _d) Frequency response	200 500 80 200 1.4 3.5 0.6	TYP. 560 1400 260 650 2.5 6.2 1.0 2.5 0.2 2.0 1.2 300		UNITS μA/mW/cm² μA/mW/cm² μA/mW/cm² μA/mW/cm² μA/mW/cm² μA/mW/cm² μA/mW/cm² μA/mW/cm² ν ν μs μs μs	λ =0.9 microns, V_{CE} =5.0 V λ =0.9 microns, V_{CE} =5.0 V 2875° K, V_{CE} =5.0 V 2875° K, V_{CE} =5.0 V λ =0.9 microns, V_{CE} =5.0 V λ =0.9 microns, V_{CE} =5.0 V λ =0.9 microns, V_{CB} =5.0 V λ =0.9 microns, λ =0.0 V λ =0.0 mA, λ =0.0 V λ =0.0 MA, λ =1.0 MA, λ —1.0 MA, λ
				****	$V_{CC}=5.0 \text{ V}, I_{C}=2.0 \text{ mA}, R_{L}=100 \Omega$

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

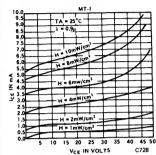


Figure 1 Collector-Emitter Characteristics

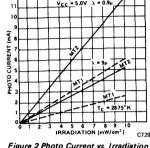


Figure 2 Photo Current vs. Irradiation

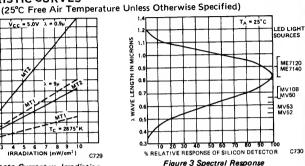


Figure 3 Spectral Response

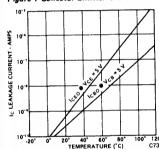


Figure 4 Leakage Current vs. Temperature

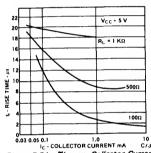
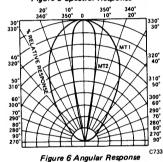


Figure 5 Rise Time vs. Collector Current



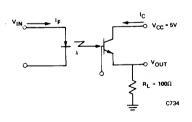


Fig. 7 Circuit Used to Obtain Switching Time vs. Collector Current Plot

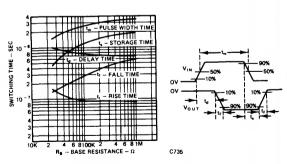


Fig. 8 Switching Time vs. Base Resistance

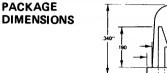
- 1. The leads of the device were immersed in molten solder, heated to a temperature of 260°C, to a point 1/16-inch from the body of the device per MIL-S-750.
- 2. Measured under dark conditions H≤1.0µW/cm².
- Measured with a GaAs light source at 0.9 microns with a radiation flux density of 3 mW/cm².
- 4. Measured with a tungsten filament lamp operated at a color temperature of 2875°K with a radiation flux density of 5 mW/cm2.

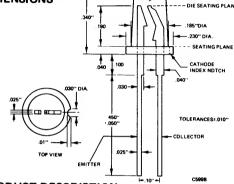
MT8020 **SILICON PHOTOTRANSISTOR**

APPLICATIONS

When used as an emitter-detector pair the MT8020 and the ME7121 or ME7124 are suitable for the following applications:

- Optical shaft position and velocity monitor using a digitally encoded disc mounted on a shaft.
- Optical sensing of holes in paper, paper tape, IBM card or magnetic tape.
- Optical sensing of marks on paper, paper tape, or IBM card.
- End of tape sensor using a transparent section of tape, a reflective strip on the tape, or a hole in the tape.
- End of film sensor for films not affected by infra-red light.
- Limit switch for mechanical travel such as cam switches, pressure switches, machine tool limit switches, foot pedal switches, safety interlock switches.
- Edge sensor for sheet materials such as paper, plastic film, fabric, foil, newsprint, belt sanders, reproduction paper.
- Fiber continuity monitor for fibers such as yarn, wire, thread
- Fluid volume monitor by sensing turbine vanes passing through the slot.
- Liquid level detector of an opaque liquid.





PRODUCT DESCRIPTION

The MT8020 is an NPN silicon planar phototransistor in a clear epoxy T-1 3/4 lamp package. The infrared emitter mates for the MT8020 are the ME7121 and the ME7124.

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Sensitivity (light current)	S _{ceo}	125	350	_	μA/mw/cm ²	V _{ce} = 5V source = GaAs (note 4)
Sensitivity (light current)	S _{ceo}	50	140	_	μΑ/ṃw/cm²	V _{ce} = 5V source = tungsten (note 3)
Collector emitter breakdown voltage	BV _{ceo}	30	65	-	Volts	I _c = 100 μA (note 2)
Collector dark current	Iceo	-	1.5	50	nA	V _{ce} = 10 V (note 2)
Emitter Collector breakdown voltage	BV _{eco}	7	12	_	Volts	$I_{\theta} = 100 \mu A$
Collector emitter saturation voltage	V _{ce} (SAT)	-	0.2	0.4	Volts	I _c = 1.6mA H = 10mw/cm ² source = GaAs (note 4)
Switching Speed	ton	-	2.5	-	μsec	$V_{cc} = 5.0 \text{ V}$ $I_c = 1.6 \text{ mA}$
	toff		1.8		μsec	$R_L = 100\Omega$ (figure 7)
Current transfer ratio –ME7124	CTR	-	2.0	-	%	V_{ce} = 5V, when coupled to ME7124 at I _f = 20mA. MPT8020 to ME7124 distance is .200"
Current transfer ratio –ME7121	CTR	-	0.5	-	%	V_{ce} = 5V, when coupled to ME7121 at I _f = 20mA. MPT8020 to ME7121 distance is .200"

ABSOLUTE MAXIMUM RATINGS

Storage and Operating Temperature -55°C to 100°C

Derate Linearly above 25°C Ambient 2.67 mW/°C Collector-Emitter Breakdown Voltage (BVCEO) 30 V

Maximum Lead Solder Time @ 230°C (See Note 1) -5.0 sec Emitter-Collector Breakdown Voltage (BV_{ECO}) 7.0 V

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

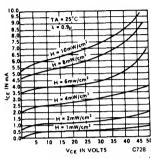


Fig. 1. Collector-Emitter Characteristics

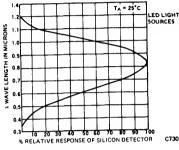


Fig. 2. Spectral Response

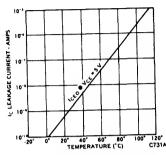


Fig. 3. Leakage Current vs. Temperature

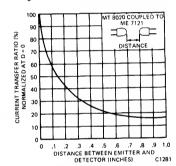


Fig. 4. Normalized Current Transfer Ratio vs. Distance Between Emitter and Detector MT8020 and ME7121.

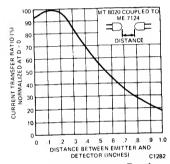


Fig. 5. Normalized Current Transfer Ratio vs. Distance Between Emitter and Detector MT8Q20 and ME7124.

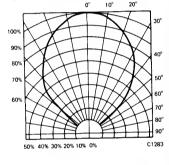


Fig. 6. Angular Response

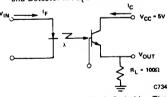
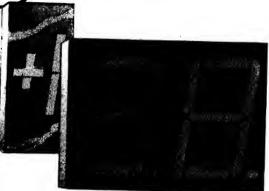


Fig. 7. Circuit Used to Obtain Switching Time Values Light Source is ME7121 or ME7124

- 1. The leads of the device were immersed in molten solder, heated to a temperature of 230°C, to a point 1/16-inch from the body of the device per MIL-S-750.
- Measured under dark conditions H≤1.0 μw/cm².
- 3. Radiation source is an unfiltered tungsten filament bulb at 2875° K color temperature. $H = 5 \text{ mW/cm}^2$.
- 4. Radiation source is a GaAs infrared emitting diode such as a ME7121 or ME7124 at $\lambda = 0.94$ microns. H = 3 mW/cm².





					BRIGHTNESS OR TUMINOUS					
1	HUAF DIGH SIZI	DI VICI	COLOR	DESCRIPTION	INFENSITY (PER SEG. MIN.)					
	8	MAN1A MAN10A	Red	.270-Inch; Common Anode; LHDP; Direct View	100 ft-L @ 20m A 100 ft-L @ 10m A					
	+/	MAN1001A MAN101A	Red	.270-Inch; Common Anode; Polarity/Overflow; Direct View	100 ft-L @ 20mA 100 ft-L @ 10mA					
		MAN2A	Red	.320-Inch; X-Y 35 Diode, Alphanumeric; Direct View	125µcd @ 10m A					
1	= 8. 8.	MAN3610A MAN51A MAN71A MAN81A	Orange Green Red Yellow	.3-Inch; Common Anode; RHDP	510μcd @ 10mA 320μcd @ 10mA 125μcd @ 10mA 510μcd @ 10mA					
	8. 8.	MAN3640A MAN54A MAN74A MAN84A	Orange Green Red Yellow	.3-Inch; Common Cathode; RHDP	510µcd @ 10mA 200µcd @ 10mA 125µcd @ 10mA 510µcd @ 10mA					
	.B .B .B	MAN3620A MAN52A MAN72A MAN82A	Orange Green Red Yellow	.3-Inch; Common Anode; LHDP	510μcd @ 10mA 320μcd @ 10mA 125μcd @ 10mA 510μcd @ 10mA					
	. <u>.</u> + <u>{</u> + <u>{</u>	MAN3630A MAN53A	Orange Green	.3-lnch; Common Anode; RHDP; Polarity & Overflow	510μcd @ 10m A 320μcd @ 10m A					
	+ <u>L</u> + <u>L</u>	MAN73A MAN83A	Red Yellow		125μcd @ 10mA 510μcd @ 10mA					
	8.	MAN4610A	Orange	.4-Inch; Common Anode; RHDP	510μcd @ 10mA					
	+/.	MAN4630A	Orange	.4-Inch; Common Anode; RHDP; Polarity & Overflow	510μcd @ 10m A					
	B .	MAN4640A	Orange	.4-Inch; Common Cathode; RHDP	510µcd @ 10mA					

1 2 3 4 5 6 7 8 9 10 11 12 13 14 Ac Fc ca NC NC DPc Ec Dc ca Cc Gc NC Bc ca C/D Common NC NC NC NC NC Dc Cc NC Bc Ac NC NC A/I Common NC NC NC NC Dc Cc NC Bc Ac NC NC Ccm Common NC NC NC NC NC Dc Cc NC Bc Ac NC NC Ccm C/D C/D C/D C/D C/D C/D C/D C/D C/D C/D C/D C/D C/D C/D	Instruments Test Equipment
C/D common NC NC NC NC NC Dc Cc NC Bc Ac NC NC NC Common NC	Instruments Test Equipment
common NC NC NC NC NC Dc Cc NC Bc Ac NC NC NC common NC	Test Equipment
mo	Computer
Col. 2 Row 1 Row 3 Row 4 Col. 1 (+) NC DP (+) Col. 3 Row 7 Row 6 (-) Row 5 (-) Col. 5 (+) Col. 6 (+)	
Ac Fc ca NP NP NC Ec Dc DPc Cc Gc NP Bc ca	
Fa Ga NP cc NP Ea Da Ca DPa NP NP cc Ba Aa	
Ac Fc ca NP NP DPc Ec Dc NC Cc Gc NP Bc ca	Instruments Test Equipment Office Machines Computers Automobiles Clocks/Radios Communication Equipment Calculators CB Radios
Ca Da NP Ca Da NP NP NP Dc Cc NC Bc Ac NP NP Aa Ba	
Ac Fc ca NP NP NC Ec Dc DPc Cc Gc NP Bc ca	Instruments
Ca Da NP Ca Da NP NP NP NC Dc Cc DPc Bc Ac NP NP NP Aa Ba DPa	Test Equipment Office Machines Computers Automobiles Clocks/Radios
Fa Ga NP cc NP Ea Da Ca DPa NP NP cc Ba Aa	Communication Equ. Calculators CB Radios

ca = common anode cc = common cathode DP = decimal point

NC = no connection NP = no pin

ACTUAL DIGIT SIZI	DIVICI NO.	COLOR	DISCRIPTION	BRIGHTNISS OR LUMINOUS INTENSITY (PERSEG, MIN.)	
日.	MAN4710A MAN4740A		.4-Inch; Common Anode; RHDP .4-Inch; Common Cathode; RHDP	200µcd @ 10mA	
+/.	MAN4705	Red	.4-Inch; Universal (Common anode or common cathode); Polarity & Overflow	200µcd @ 10mA	
B.E	MAN6610 MAN6640		.560-Inch; Common Anode; RHDP; 2-Digit .560-Inch; Common Cathode; RHDP; 2-Digit	510μcd @ 10mA	
B.E	MAN6710 MAN6740	Red Red	.560-Inch; Common Anode; RHDP; 2-Digit .560-Inch; Common Cathode; RHDP; 2-Digit	200µcd @ 10mA	
+1.E	MAN6630 MAN6650	Orange Orange	.560-Inch; Common Anode; RHDP; 1½-Digit .560-Inch; Common Cathode; RHDP; 1½-Digit	510μcd @ 10mA	
+1.E	MAN6730 MAN6750	Red Red	.560-Inch; Common Anode; RHDP; 1½-Digit .560-Inch; Common Cathode; RHDP; 1½-Digit	200µcd @ 10mA	
8.	MAN6660 MAN6680	Orange Orange	.560-Inch; Common Anode; RHDP .560-Inch; Common Cathode; RHDP	510µcd @ 10mA	
8.	MAN6760 MAN6780	Red Red	.560-Inch; Common Anode; RHDP .560-Inch; Common Cathode; RHDP	200µcd @ 10mA	
	MAN8610 MAN8630 MAN8640 MAN8650	Orange Orange Orange Orange	.800-Inch; Common Anode; RHDP .800-Inch; Common Anode; RHDP; ±1Overflow .800-Inch; Common Cathode; RHDP .800-Inch; Common Cathode; RHDP; ±1Overflow	600µcd @ 10mA	
(Total o	MAN2815 f sts)	Red	.135-Inch; Common Anode; 14 Segment Alphanumeric; 8-Characters	60µсd @ 2.5mA (avge. curr.)	

						-	el× co	NI (HONS	(See n	ote)							
	,	3	1	,	6		,	,	10	11	12	13	14	15	16	15	18	APPLICATIONS
Ac Fa	Fc Ga	ca NP	NP cc	NP NP	NC Ea	Ec Da	Dc Ca	DPc DPa	1	Gc NP	NP cc	Ec Ba	ca Aa	-	-	-	-	Instruments Test Equipment Office Machines Computers
Dla	NP	D1c	Cc	D2c	D2a	Ca	DPa	NP	DPc	Вс	Ac	Aa	Ва	-	-	-	-	Automobiles Clocks/Radios Communication Equipment Calculators CB Radios
Ec1 Ea1	Dc1 Da1	Cc1 Ca1	DPc1 DPa1		Dc2 Da2	Gc2 Ga2	Cc2 Ca2	DPc2 DPa2		Ac2 Aa2	Fc2 Fa2	ca2 cc2	cal ccl	Bc1 Ba1	Ac1 Aa1	Gc1 Ga1	Fc1 Fa1	
Ec1 Ea1	Dc1 Da1	Cc1	DPc1 DPa1	i	Dc2 Da2	Gc2 Ga2	Cc2 Ca2	DPc2 DPa2		Ac2 Aa2	Fc2 Fa2	ca2 cc2	cal ccl	Bc1 Ba1	Ac1 Aa1	Gc1 Ga1	Fc1 Fa1	
Cc1 Ca1	Dc1 Da1		DPc1 DPa1	Ec2 Ea2	Dc2 Da2	Gc2 Ga2	Cc2 Ca2	DPc2 DPa2	Bc2 Ba2	Ac2 Aa2	Fc2 Fa2	ca2 cc2	ca1	Ac1 Aa1	NC NC	NC NC	NC NC	
Cc1 Ca1	Dc1 Da1		DPc1 DPa1	Ec2 Ea2	Dc2 Da2	Gc2 Ga2	Cc2 Ca2	DPc2 DPa2	Bc2 Ba2	Ac2 Aa2	Fc2 Fa2	ca2 cc2	cal ccl	Ac1 Aa1	NC NC	NC NC	NC NC	POS Terminals Computers Instruments Test Equipment Clocks/Radios TV Channel
Ec Ea	Dc Da	ca cc	Ca Ca	DPc DPa	Bc Ba	Ac Aa	ca cc	Fc Fa	Gc Ga	-	-	_		-	-	-	-	Indicators
Ec Ea	Dc Da	ca cc	Cc Ca	DPc DPa	Bc Ba	Ac Aa	ca cc	Fc Fa	Gc Ga	-	_	-	-	-	-	-	-	
NC	Ac NC Aa NC	Fc NC Fa NC	ca ca cc cc	Ec Cc Ea Ca	NP NP NP NP	Cc Ea	NP NP NP NP	D2c cc	DPa	Dc D1c Da D2a	ca ca cc cc	Cc Bc Ca Ba	Gc D2c Ga D1a	Ac Ba	NP NP NP NP	cc	NP NP NP NP	
							•	!				_						Compact Computers Test Equipment Desk Top Calculators Commun. Equip. Verification Sys.

ca = common anode cc = common cathode DP = decimal point

NC = no connection NP = no pin

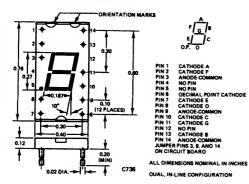
MAN1A MAN10A

.27" RED SEVEN SEGMENT DISPLAY

PRODUCT DESCRIPTION

The MAN1A and MAN10A are seven segment diffused planar GaAsP light emitting diode arrays. They are mounted on a dual in-line 14 pin substrate and then encapsulated in red epoxy for protection. They are capable of displaying all digits and nine distinct letters.

PACKAGE DIMENSIONS



FEATURES

- High brightness...
- Categorized for luminous intensity (see note 6)
- Single plane, wide angle viewing . . . 150°
- Unobstructed emitting surface
- Standard 14 pin dual-in-line package configuration
- Long operating life . . . solid state reliability
- Shock resistant
- Operates with IC voltage requirements
- Small size; offering unique styling advantages
- All numbers plus 9 distinct letters
- Usable for wide viewing angle requirements
- Usable in vibrating environment, impervious to vibration
- Directly compatible with integrated circuits

The MAN1A/MAN10A is for industrial and military applications such as:

- Digital readout displays
- Cockpit readout displays

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25 Cambient		750 mW
Derate linearly from 25°C		10
Storage and operating temp		10 IIIW/ C
Continuous forward current		2 to 100°C
Total		240 m A
Per segment	*************************	20 mA
Decimal point		30 mA
Reverse Voltage		30 mA
Per segment		10.0
Decimal point		TO.O VOITS
Solder time at 260°C (see note 5)		5.U VOITS

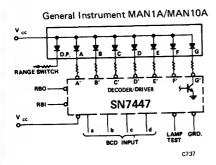
ELECTRO-OPTICAL CHARACTERISTICS

(25°C Ambient Temperature Unless Otherwise Specified)

CHARACTERISTICS		MIN. TY		MAX.	UNITS	TEST CONDITIONS		
						MAN1A	MAN10A	
	Luminous Intensity (note 1 a	nd 6)						
	Segment	74			μcd	I _F =20 mA, λ=660 nm	I _E =10 mA, λ 660 nm	
	Decimal point	74			μcd	I _F =20 mA, λ=660 nm	I _F =10 mA, λ 660 nm	
	Peak emission wave length	630		700	nm	1F 20 111A, X-000 11111	1F-10 IIIA, X 000 IIIII	
	Spectral line half width		20		nm			
	Forward voltage							
	Segment		3.4	4.0	V	I _F =20 mA	I _F =10 mA	
	Decimal point		1.6	2.0	v	I _F =20 mA	IF=10 mA	
	Dynamic resistance				•	1F -20 IIIA	IF-10 IIIA	
	Segment		11		Ω	I _F =20 mA	l ₌ =20 mA	
	Decimal point		5.5		Ω	I _E =20 mA	I _F =20 mA	
	Capacitance		0.0		45	1F -20 IIIA	1F-20 MA	
	Segment		80		рF	V=0	V=0	
	Decimal point		135		pF	V=0	V=0	
	Reverse Current		.00		p.	V-0	V=0	
	Segment			100	μΑ	V _R =10.0 volts	V. =100le	
	Decimal point			100	μΑ	VR= 5.0 volts	V _R =10.0 volts	
				.50	μΑ	AM- 9'0 AOICE	$V_R = 5.0 \text{ volts}$	

DECODER/DRIVER **FUNCTIONAL DIAGRAM**





TYPICAL TRUTH TABLE

IN	PUT	CODI	E	OUTPUT STATE							DISPLAY
d	С	b	а	A'	B'	C'	D'	E'	F'	G'	
0	0	0	0	0	0	0	0	0	0	1	<i>a</i>
0	0	0	1	1	0	0	1	1	1	1	1
0	0	1	0	0	0	1	0	0	1	0	2
0	0	1	1	0	0	0	0	1	1	0	3
0	1	0	0	1	0	0	1	1	0	0	4
0	1	0	1	0	1	0	0	1	0	0	5
0	1	1	0	1	1	0	0	0	0	0	Ь
0	1	1	1	0	0	0	1	1	1	1	7
1	0	0	0	0	0	0	0	0	0	0	8
1	0	0	1	0	0	0	1	1	0	0	9
	d 0 0 0 0 0 0 0 1	d c 0 0 0 0 0 0 0 1 0 1 0 1 1 0 1	d c b 0 0 0 0 0 0 0 0 1 0 0 1 0 1 0 0 1 1 0 1 1 1 0 0	0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0	d c b a A' 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 0 1 0 0 1 0 1 0 0 1 0 1 1 0 1 0 1 1 0 1 1 0 0 0 0	d c b a A' B' 0 0 0 0 0 0 0 0 0 1 1 0 0 0 1 0 0 0 0 0 1 1 0 0 0 1 0 0 1 0 0 1 0 1 0 1 0 1 1 0 1 1 0 1 1 1 0 0 1 0 0 0 0 0	d c b a A' B' C' 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 1 0 0 0 1 0 1 0 0 0 0 0 0 1 0 1 0 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 0	d c b a A' B' C' D' 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 0 0 1 0 0 0 1 0 0 1 0 0 1 0 0 0 0 1 0 1 0 0 1 0 0 1 1 0 1 0 0 1 0 1 1 0 0 0 0 0 0 1 1 0 0 0 0 0 1 1 0 0 0 0 0 0	d c b a A' B' C' D' E' 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 0 1 1 0 1 0 0 1 0 0 1 1 0 1 1 0 1 0 0 1 1 0 1 1 0 1 1 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0	d c b a A' B' C' D' E' F' 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 1 1 1 0 0 1 0 0 1 0 0 1 1 1 0 1 0 0 0 0 1 1 0 0 0 1 1 0 0 1 0 1 0 0 0 1 0 </th <th>d c b a A' B' C' D' E' F' G' 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 1 1 1 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 1 0<</th>	d c b a A' B' C' D' E' F' G' 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 1 1 1 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 0 1 0<

TYPICAL CURVES

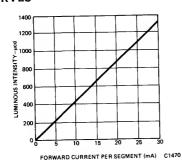


Figure 1 Luminous Intensity vs. Forward Current

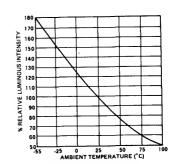


Figure 2 Luminous Intensity vs. Temperature

C1145

TYPICAL THERMAL CHARACTERISTICS Thermal Resistance (note 4) Junction to free air Θ _{JA}	
Thermal Resistance (note 4) Junction to free air eja	

NOTES

- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than ± 50% between all segments.
- 2. The curve in Figure 2 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. For contrast improvement Polaroid HRCP7 circular polarizer filter can be used. Non-glare circular polarizer filter will provide further enhancement in display visibility.
- 4. Thermal resistance (junction to ambient) value of any one segment with all segments in operation.
- 5. Leads of the device immersed to 1/16 inches from the body. Maximum device surface temperature is 140°C.

6. All displays are categorized for luminous intensity. The intensity category is marked on each part as a suffix letter to the part number.

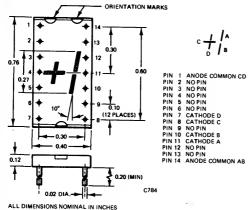
MAN101A MAN1001A

.27" RED POLARITY AND OVERFLOW DISPLAY

PRODUCT DESCRIPTION

The MAN101A and MAN1001A are four segment diffused planar GaAsP LED arrays. They are mounted on a dual in-line 14 pin substrate and then encapsulated in red epoxy for protection. They are designed to present polarity and overflow information when used with the MAN1A/10A seven segment displays.

PACKAGE DIMENSIONS



DUAL, IN-LINE CONFIGURATION

FEATURES

- High brightness . . .
- Categorized for luminous intensity (see note 6)
- Single plane, wide angle viewing . . . 150°
- Unobstructed emitting surface
- Standard 14 pin dual-in-line package configuration
- Long operating life . . . solid state reliability
- Shock resistant
- Operates with IC voltage requirements
- Small size; offering unique styling advantages
- Usable for high ambient applications
- Usable in vibrating environment, impervious to vibration

The MAN101 and MAN1001 are for industrial and military applications such as:

- Digital readout displays
- Cockpit readout displays
- Battery operated equipment

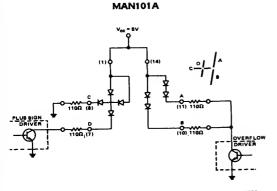
ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient	400 144
Derate linearly from 25°C	480 mw
Storage and operating temp	.6.4 mw/°C
Continuous forward current	C 10 100°C
Total	120 0
Per segment	120 mA
Reverse Voltage	30 mA
Per segment	100
Solder time at 260°C (see note 5)	. 10.0 voits

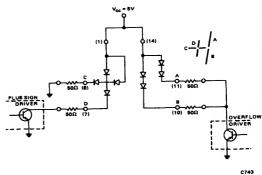
ELECTRO-OPTICAL CHARACTERISTICS (25°C Ambient Temperature Unless Otherwise Specified)

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS			
Luminous intensity (note 1	and 6)				MAN101A	MAN1001A		
Segment Peak emission wave length Spectral line half width	74 630	20	700	μcd nm nm	$I_F = 10 \text{ mA}, \lambda = 650 \text{ nm}$	I _F = 20 mA, λ 650 nm		
Forward voltage Segment Dynamic resistance		3.4	4.0	v	I _F = 10 mA	I _F = 20 mA		
Segment Capacitance		11		Ω	1 _F = 20 mA	I _F = 20 mA		
Segment Reverse Current		80		pF	V = 0	V = 0		
Segment			100	μΑ	$V_R = 10.0 \text{ volts}$	$V_R = 10.0 \text{ volts}$		

DRIVING CIRCUITRY



MAN1001A



NOTE:

- nt requires 10 mA

TYPICAL CURVES

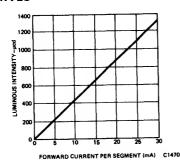


Figure 1 Luminous Intensity vs. Forward Current

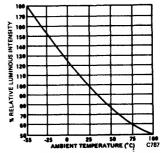


Figure 2 Luminous Intensity vs. Temperature

THERMAL CHARACTERISTICS

Thermal Resistance (note 4) Junction to f	• • • • • • • • • • • • • • • • • • • •	440°C AM
Thermal Besistance (note 4) Junction to f	ree air 🖰 🗚	
(Herrial Resistance (Hote 4) suitcher to	TOO UNITED THE STATE OF THE STA	3 0 \$ /°C
Wavelength Temperature Coefficient (case	e temp)	
Forward Voltage Temperature Coefficien		-4.0 mV/°C
Earward Voltage Temperature Coefficien	1	

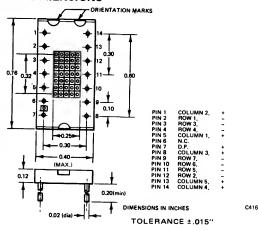
- 1. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than ±50% between all segments.
- 2. The curve in Figure 2 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. For contrast improvement Polaroid HRCP7 circular polarizer filter can be used. Non-glare circular polarizer filter will provide further enhancement in display visibility.
- 4. Thermal resistance (junction to ambient) value of any one segment with all segments in operation.
- 5. Leads of the device immersed to 1/16 inches from the body. Maximum device surface temperature is 140°C.
- 6. All displays are categorized for luminous intensity. The luminous category is marked on each part as a suffix letter to the part number.

MAN2A .32" RED ALPHA-NUMERIC DISPLAY

PRODUCT DESCRIPTION

The MAN2A is a 35 diode diffused planar GaAsP LED alpha-numeric array with a decimal point. It is mounted on a dual in-line, 14-pin substrate with a high contrast red epoxy lens. It is capable of displaying the 64 character ASCII code.

PACKAGE DIMENSIONS



FEATURES & APPLICATIONS

- X-Y matrix drive
- Visible, bright red, high contrast display
- Categorized for luminous intensity (see note 5)
- 36 light emitting diodes including decimal point
- Capable of displaying 64 ASCII characters
- Single plane, wide angle viewing
- Long life, shock resistant, small size

It is ideal for industrial and military applications such as:

- Keyboard verifier
- Film annotation—236 bits available
- Avionics display
- Computer peripheral displays

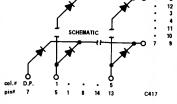
ABSOLUTE MAXIMUM RATINGS

Single Diode DC forwar

DC forward current	20 mA
Pulsed forward current peak (50 μ s, 20% duty cycle)) 100 mA
Reverse voltage	5 V
Storage temperature	40°C to 85°C
Operating temperature	-40°C to 85°C

Diode Array

Average power dissipation @ 25°C ambient 750 mW
Derate linearly from 25°C
DC current per diode for worst case A/N
DC current per diode for all 35 diodes plus DP
Solder time at 260°C (notes 3, 4)



ELECTRO-OPTICAL CHARACTERISTICS (PER DIODE)

(25°C Ambient Temperature Unless Otherwise Specified)

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Average Luminous intensity per character (See note 1 and 5)	125			μcd	I _F = 10 mA
Peak emission wavelength		660		nm	1F - 10 IIIA
Spectral line half width Forward voltage		20		nm	
Capacitance			2.0	V	I _F = 20 mA
Reverse current		200		pF	V = 0
			100	μΑ	V _P = 5 V

TYPICAL CURVES

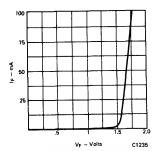


Fig. 1. Forward Current vs. Forward Voltage each LED

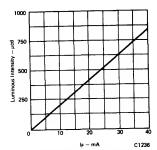


Fig. 2. Light Intensity vs. Forward Current each LED

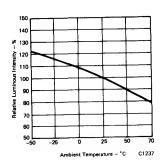


Fig. 3. Relative Luminous Intensity vs. Ambient Temperature

NOTES

- 1. The characteristic average luminous intensity is obtained by summing the luminous intensity of each diode and dividing by 35. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than ±33.3% between all diodes in a character.
- 2. The curve in Figure 3 is normalized to the brightness of 25°C to indicate the relative luminous intensity over the operating temperature range.
- 3. Leads of the device immersed to 1/16 inches from the body. Maximum device surface temperature is 140°C.
- 4. For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.
- 5. All displays are categorized for luminous intensity. The luminous intensity category is marked on each part as a suffix letter to the part number.

RECOMMENDED FILTERS

For optimum on and off contrast, one of the following filters or equivalents should be used over the display:

Panelgraphic Red 60 Homalite 100-1670

GENERAL INSTRUMENT Optoelectronics

MAN2815 .135" RED 8-CHARACTER 14-SEGMENT ALPHA-NUMERIC DISPLAY

FEATURES

- Low Power Consumption
 - (As low as 0.5 mA everage current or 1.0 mw per segment,)
- Aesthetically designed cherecters.
 Sculptured continuous segments.
- Complete Alphe-numerics plus speciel cherecters.
- Voltage and current compatibility for interfacing eese with microprocessors and related circuitry.
- 0.135" charecter haight
- 0.175" cheracter specing allowing as much as 32 characters in 5.6" linear panel space.
- Common Cethode
- Internally wired for multiplexing.



- Computer terminels—lightweight, mobile, compect.
- Test & Meesurement Equipment
- Desk Top Calculators
- Automotive Instrumentation
- Communications—message centers.
- Verification Systems





DESCRIPTION

The MAN2815 is an eight-cheracter alphe-numeric display which is end-stackeble and cepeble of displaying ell elphe and numeric characters plus symbols. Each character is constructed from a monolithic, red GeASP chip formated into e 14-segment font with a decimal point.

ABSOLUTE MAXIMUM RATINGS

Average Forward Current par Segment	10 mA
Peak Forward Current per Segment	250 mA
(≤200 μs, ≤4% duty cycle)	
Reverse Voltage	5.0 volts
Storage & Operating Temperature	-40°C to 85°C
Solder temperature (t ≤5 sec)	260°C
(See notes 2 & 3)	200 C
Average Power Dissipetion (Total Package)	1200 mW
@ T _A = 50°C	1200 1111
Darate Linearly from 50°C:	17.1 mW/°C

NOTES

- The average Luminous Intensity per segment is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments as measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D).
- 2. Leads immersed to 1/16" from the body of the device. Maximum unit surface temperature is 140°C.
- 3. For flux removal, use Freon TE, Isoproponal, or water may be used up to their boiling points.

ELECTRICAL OPTICAL CHARACTERISTICS (TA = 25°C)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
Average Luminous Intensity per Segment (See Note 1)	60	100		μcd	I _{avg} = 2.5 mA I _{pk} = 20 mA Duty cycle = 1/8	
Luminous Intensity Ratio			2.0:1			
Segment-to-Segment within a character Luminous Intensity Ratio,			2.0:1			
Character-to-Character within a display Forward Voltage		1.65	2.0	volts	$I_{pk} = 20 \text{ mA}$ $I_{R} = 100 \mu \text{A/segment}$	
Reverse Voltage Peak Emission Wavelength	5.0	660		volts nm	IR- 100 μA/segment	

ELECTRICAL/OPTICAL CONSIDERATIONS

A. DETERMINATION OF MAXIMUM ALLOWABLE STROBING CONDITIONS:

1. From number of characters, determine duty cycle (DC).

Ex: 32 Characters

DC = 1/32 = 3.125%

2. Establish refresh frequency (f) and calculate pulse duration (PW).

Ex: f = 500 HZ

 $PW = DC/f = .03125/500 HZ = 62.5 \mu s$

- The corresponding maximum peak current per segment from Fig. 1 is 250 mA. The intersection of 500 HZ and 62.5 µs pulse duration
 lies in the <4% duty cycle condition. IAVG = 250 mA X .03125 = 7.8 mA which is the maximum average current for operation at
 TA (ambient temperature) = 25° C.
- If operating temperature is above 50°C, then power dissipation must be derated. Using Derating Factor of -17.1 mW/°C for total package: Or see Fig. 4.

Ex: TA = 70°C

 $1200 \text{ mW} - (70^{\circ}\text{C} - 50^{\circ}\text{C}) \text{ X } (17.1 \text{ mW/}^{\circ}\text{C}) = 858 \text{ mW/package}$

DR 107 mW/character

Assume normal operation where there are no greater than 8 segments on at one time within a character. Then average power (P_{AVG}) (max)/segment = 13.4 mW/seg. At a peak current of 250 mA, maximum $V_F = 2.4V$; which yields:

$$I_{AVG} = \frac{13.4}{2.4} = 5.58$$
 mA which is the max. avg. current for operation up to $T_A = 70^{\circ}$ C.

- B. DETERMINATION OF THE OPERATION WITHIN THE ALLOWABLE CONDITIONS AS ESTABLISHED BY THE AMBIENT SURROUNDING.
 - Ex: Assume ambient light defines the average luminous intensity for each segment to be 120 μcd.
 32 characters; DC = 3.125%
 - 2. Establish IAVG and calculate IPK.

Referring to Fig. 2, 120 μ cd at a duty cycle of 3.125% corresponds to I_{AVG} = 2.5 mA/seg.

$$\therefore I_{PK} = \frac{2.5 \text{ mA}}{.03125} = 80 \text{ mA/seg.}$$

RECOMMENDED FILTERS

The following filters or equivalent are recommended to provide optimum ON and OFF contrast ratio:

PANELGRAPHIC RED 60 HOMALITE 100-1605 PLEXIGLAS 2423

TYPICAL CURVES (unless otherwise noted)

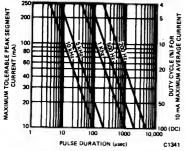


Fig. 1. Maximum Tolerable Peak Segment Current vs. Pulse Duration

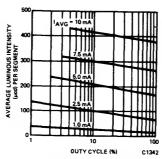


Fig. 2. Average Luminous Intensity/Segment vs. Duty Cycle

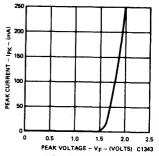


Fig. 3. Peak Current vs. Peak Voltage

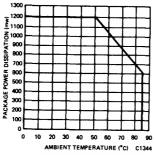


Fig. 4. Mex. Tolerable Power Dissipation

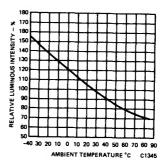


Fig. 5. Luminous Intensity vs. Temperature

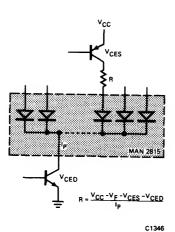


Fig. 6. Display Drive Consideration

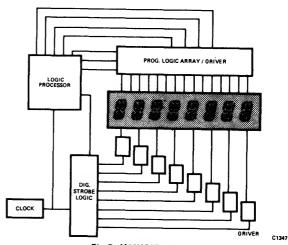
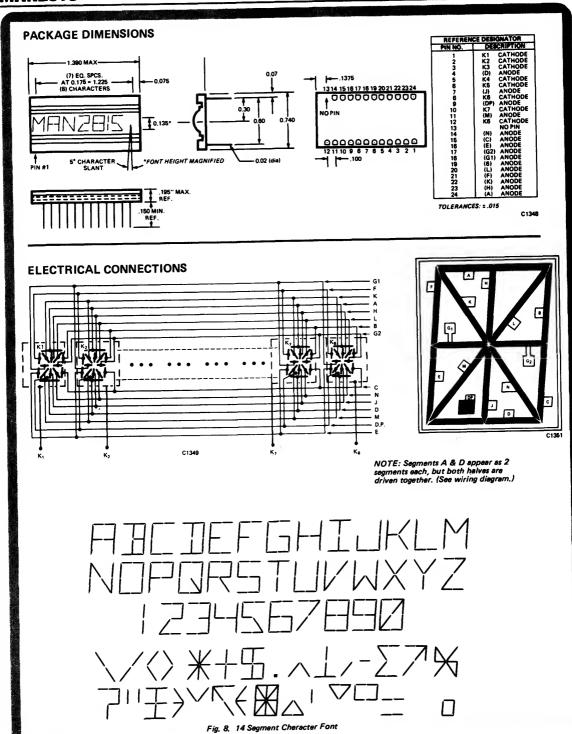


Fig. 7. MAN2815 in a Typical Application



GENERAL INSTRUMENT
Optoelectronics

0.300-INCH SEVEN SEGMENT DISPLAY GREEN ORANGE RED YELLOW MAN50A MAN3600A MAN70A MAN80A



FEATURES

企图在2001年11日

- Common anode or common cathode models
- Red, yellow, green and orange
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for luminous intensity (see note 6)
- Standard 14 pin dual in-line package configuration
- Wide angle viewing . . . 150°

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Calculators

Digital clocks

DESCRIPTION

The MAN50A, MAN3600A, MAN70A and MAN80A Series provides a choice of color of LED displays. Standard units are available in red, green, orange and yellow, with common anode right hand decimal, common anode left hand decimal, common cathode right hand decimal, and common anode overflow (±1) with right hand decimal. They can be mounted in arrays with 0.400-inch (10.16 mm) center-to-center spacing.

MODEL NUMBERS

PART NO.	COLOR
MAN51A	Green
MAN52A	Green
MAN53A	Green
MAN54A	Green
MAN3610A	Orange
MAN3620A	Orange
MAN3630A	Orange
MAN3640A	Orange
MAN71A	Red
MAN72A	Red
MAN73A	Red
MAN74A	Red
MAN81A	Yellow
MAN82A	Yellow
MAN83A	Yellow
MAN84A	Yellow

DESCRIPTION

Common Anode; Right Hand Decimal Common Anode; Left Hand Decimal Common Anode; Overflow ±1 Common Cathode; Right Hand Decimal Common Anode; Right Hand Decimal Common Anode: Left Hand Decimal Common Anode; Overflow ±1 Common Cathode; Right Hand Decimal Common Anode; Right Hand Decimal Common Anode; Left Hand Decimal Common Anode; Overflow ±1 Common Cathode; Right Hand Decimal Common Anode; Right Hand Decimal Common Anode; Left Hand Decimal Common Anode; Overflow ±1 Common Cathode; Right Hand Decimal

	CTRO-OPTICAL CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITION
	D: 11 A				μcd	I _F = 10 mA
ı	Luminous intensity, Digit Average (See Note 1)	125			pace.	•
- 1	Decimal point (See Note 3)	60			μcd	I _F = 10 mA
a	Segment "C" or "D" of MAN53A	60			μcd	I _F = 10 mA
54A	Peak emission wavelength		565		nm	
ا ز	Spectral line half width		40		nm	
53A,	Forward voltage			3.0	V	I _F = 20 mA
ا ز	Segment			3.0	v	I _F = 20 mA
8	Decimal point			0.0	•	•
r,	Dynamic resistance Segment		17		Ω	I _F = 20 mA
MAN51A, 52A,	Decimal point		17		Ω	i _F = 20 mA
9	Capacitance					V = 0
 ■	Segment		35		pF pF	V = 0 V = 0
≥	Decimal point		35		PΓ	• •
- 1	Reverse current			100	μA	V = 5.0 V
1	Segment Designal point			100	μA	V _R = 5.0 V V _R = 5.0 V
Į	Decimal point					
T	Luminous intensity, Digit Average	510			μcd	I _F = 10 mA
4	(See Note 1)					I _F = 10 mA
3640A	Decimal point (See Note 3)	265			μcd μcd	I _F = 10 mA
8	Segment "C" or "D" of MAN3630A	265	630		μcu nm	iF - 10 iii/
₹ l	Peak emission wavelength		40		nm	
3630A,	Spectral line half width		40			
8	Forward voltage Segment			2.5	V	I _F = 20 mA
انه	Decimal point			2.5	V	I _F = 20 mA
2	Dynamic resistance				0	1 = 20 m A
8	Segment		26		Ω	I _F = 20 mA I _F = 20 mA
انز	Decimal point		26		22	IF - 20 IIIA
9	Capacitance		35		ρF	V = 0
<u>ا</u> چ	Segment		35		pF	V = 0
ž	Decimal point Reverse current		-		•	
MAN3610A, 3620A,	Segment			100	μΑ	V _R = 5.0 V V _R = 5.0 V
-	Decimal point			100	μΑ	V _R = 5.0 V
\dashv	A contract the Digit Augrage	125			μcd	I _F = 10 mA
	Luminous intensity, Digit Average (See Note 1)	125			,	
- 1	Decimal point (See Note 3)	60			μcd	$I_F = 10 \text{ mA}$
∢	Segment "C" or "D" of MAN73A	60			μcd	I _F = 10 mA
4	Peak emission wavelength		660		nm	
·	Spectral line half width		20		nm	
8	Forward voltage			2.0	V	I _F = 20 mA
51	Segment			2.0	v	I _F = 20 mA
7	Decimal point			2.0		•
51	Dynamic resistance Segment		2		Ω	I _{PK} = 100 mA
اخ	Decimal point		2		Ω	I _{PK} = 100 mA
2	Capacitance					V = 0
MAN71A, 72A, 73A, 74A	Segment		35	80		V = 0 V = 0
2	Decimal point		35	80		
	Reverse current			100	μΑ	V _R = 5.0 V V _R = 5.0 V
	Segment Decimal point			100	μ A	V _R = 5.0 V
\dashv					ued	I _F = 10 mA
ĺ	Luminous intensity, Digit Average	320			μcd	iF - 10 IIIV
	(See Note 1) Decimal point (See Note 3)	160			μcd	$I_F = 10 \text{ mA}$
ا ر	Segment "C" or "D" of MAN83A	160			μcd	I _F = 10 mA
84A	Peak emission wavelength		585		nm	
	Spectral line half width		40		nm	
8	Forward voltage			3.0	V	le = 20 mA
MAN81A, 82A, 83A	Segment			3.0 3.0	v	I _F = 20 mA I _F = 20 mA
8	Decimal point			U .U	•	1
ω	Dynamic resistance Segment		26		Ω	I _F = 20 mA
¥.	Decimal point		26		Ω	I _F = 20 mA
9	Capacitance				_	V = 0
Ž	Segment		35		pF oF	V = 0 V = 0
Σ	Decimal point		35		pF	
	Reverse current			100	μА	V _R = 5.0 V V _R = 5.0 V
	Segment			100	μA	V = 5.0 V

TYPICAL CURVES

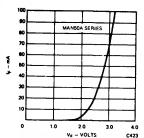


Fig. 1. Forward Current vs. Forward Voltage

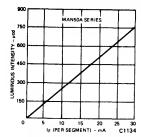


Fig. 2. Luminous Intensity vs. Forward Current

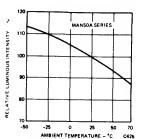


Fig. 3. Luminous Intensity vs. Temperature

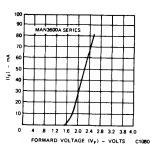


Fig. 4. Forward Current vs. Forward Voltage

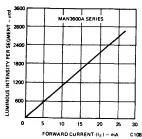


Fig. 5. Luminous Intensity vs. Forward Current

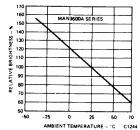


Fig. 6. Luminous Intensity vs. Temperature

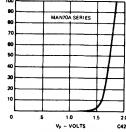


Fig. 7. Forward Current vs. Forward Voltage

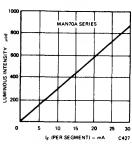


Fig. 8. Luminous Intensity vs. Forward Current

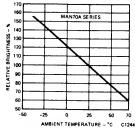


Fig. 9. Luminous Intensity vs. Temperature

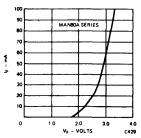


Fig. 10. Forward Current vs. Forward Voltage

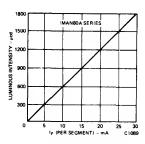


Fig. 11. Luminous Intensity vs. Forward Current

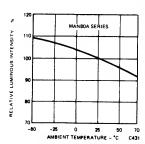


Fig. 12. Luminous Intensity vs. Temperature

20 30 50 80 100

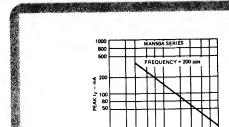


Fig. 13. Max Peak Current vs. Duty Cycle

5 8 10

DUTY CYCLE - %

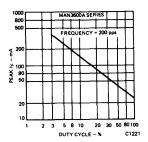


Fig. 15. Max Peak Current vs. Duty Cycle

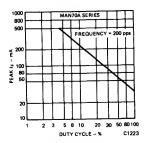


Fig. 17. Max Peak Current vs. Duty Cycle



Fig. 19. Max Peak Current vs. Duty Cycle

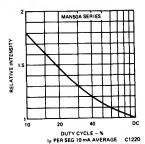


Fig. 14. Luminous Intensity vs. Duty Cycle

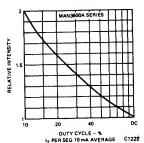


Fig. 16. Luminous Intensity vs. Duty Cycle

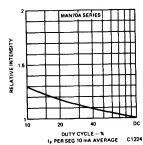


Fig. 18. Luminous Intensity vs. Duty Cycle

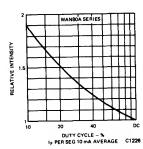
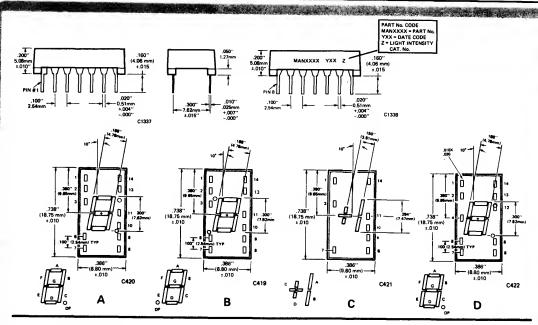


Fig. 20. Luminous Intensity vs. Duty Cycle

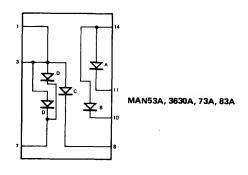
MAN50A MAN3600A MAN70A MAN80A SERIES 107



PIN CONNECTIONS

		ELECTRICAL	CONNECTIONS	
PIN	ΑΑ	В	С	D
NO.	MAN51A, 3610A, 71A, 81A	MAN52A, 72A, 3620A, 82A	MAN53A, 3630A, 73A, 83A	MAN54A, 3640A, 74A, 84A
1	Cathode A	Cathode A	Anode C. D	Anode F
2	Cathode F	Cathode F	No pin	Anode G
3	Common anode	Common anode	Anode C, D	No pin
4	No pin	No pin	No pin	Common cathode
5	No pin	No pin	No pin	No pin
6	N.C.	Cathode D.P.	No pin	Anode E
7	Cathode E	Cathode E	Cathode D	Anode D
8	Cathode D	Cathode D	Cathode C	Anode C
9	Cathode D.P.	N.C.	N.C.	Anode D.P.
10	Cathode C	Cathode C	Cathode B	No pin
11	Cathode G	Cathode G	Cathode A	No pin
12	No pin	No pin	No pin	Common cathode
13	Cathode B	Cathode B	No pin	Anode B
14	Common anode	Common anode	Anode A, B	Anode A

ELECTRICAL SCHEMATIC



108 MAN5OA MAN36OOA MAN7OA MAN8OA SERIES

BSOLUTE MAXIMUM RATINGS	GRE	EN	RE	D
	MAN51A MAN52A MAN54A	MAN53A	MAN71A MAN72A MAN74A	MAN73A
Power dissipation @ 25°C ambient	480 mW	300 mW	480 mW	300 mW
Derate linearly from 50°C	-9.6 mW/°C	-6.0 mW/°C	-6.9 mW/°C	-4.29 mW/°C
Storage and operating temperature	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C
Continuous forward current TotalPer segment Decimal point	160 mA	100 mA	240 mA	150 mA
	20 mA	20 mA	30 mA	30 mA
	20 mA	20 mA	30 mA	30 mA
Reverse voltage Per segment	6.0 V	6.0 V	6.0 V	6.0 V
	6.0 V	6.0 V	6.0 V	6.0 V
	5 sec.	5 sec.	5 sec.	5 sec.
	YEL	LOW	ORA	NGE
	MAN81A MAN82A MAN84A	MAN83A	MAN3610A MAN3620A MAN3640A	MAN3630A
Power dissipation @ 25°C ambient Derate linearly from 25°C	600 mW	375 mW	600 mW	375 mW
	-10.3 mW/°C	-6.43 mW/°C	-8.6 mW/°C	-5.36 mW/°C
	-40°C to +85°C	-40°C t <i>o</i> +85°C	-40°C to +85°C	-40°C to +85°(
Continuous forward current Total	200 mA	125 mA	240 mA	150 mA
	25 mA	25 mA	30 mA	30 mA
	25 mA	25 mA	30 mA	30 mA
Reverse voltage Per segment Decimal point	6.0 V	6.0 V	6.0 V	6.0 V
	6.0 V	6.0 V	6.0 V	6.0 V
	5 sec.	5 sec.	5 sec.	5 sec.

For optimum on and off contrast, one of the following filters or equivalents should be used over

DEVICE TYPE	FILTER	DEVICE TYPE	FILTER
MAN51A MAN52A MAN53A	Panelgraphic Green 48	MAN71A MAN72A MAN73A	Panelgraphic Red 60 Homalite 100-1605
MAN54A MAN3610A MAN3620A MAN3630A MAN3640A	Panelgraphic Scarlet 65 Homalite 100-1670	MAN74A / MAN81A MAN82A MAN83A MAN84A	Panelgraphic Yellow 25 or Amber 23 Homalite 100-1720 or 100-1726

TYPICAL THERMAL CHARACTERISTICS

GREEN/YELLOW Thermal resistance junction to free air Φ_{JA}	
RED/ORANGE Thermal resistance junction to free air Φ_{JA} Wavelength temperature coefficient (case temp)	160°C/W

NOTES:

- 1. The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments as measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than $\pm 33.3\%$ between all segments within a digit.
- 2. The curve in Fig. 3, 6, 9, and 12 is normalized to the brightness at 25°C to indicate the relative luminous intensity
- over the operating temperature range. 3. The decimal point is designed to have the same surface brightness as the segments; therefore, the luminous intensity of the decimal point is .3 times the luminous intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.
 - 4. Leads of the device immersed to 1/16-inches from the body. Maximum device surface temperature is 140°C.
 - 5. For flux removal, Freon TF, Freon TE, Isoproponal or water may be used up to their boiling points.
- 6. All displays are categorized for luminous intensity. The intensity category is marked on each part as a suffix letter to the part number.

GENERAL INSTRUMENT Optoelectronics

GREEN MAN4500 SERIES
ORANGE MAN4600 SERIES
RED MAN4700 SERIES
YELLOW MAN4800 SERIES
0.400-INCH SEVEN SEGMENT DISPLAY

FEATURES

- Common anode or common cathode models
- Red, yellow, green and orange
- Fast switching-excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Impact resistant plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for luminous intensity (see note 6)
- Standard 14 pin dual in-line package configuration
- Wide angle viewing . . . 150°
- Package size and lead configuration is the same as MAN50A/3600A/70A/80A Series

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point of sale equipment
- Calculators
- Digital clocks
- High ambient light conditions





DESCRIPTION

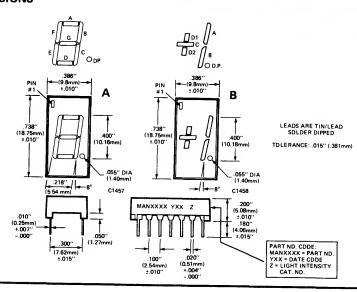
The MAN4500, MAN4600, MAN4700 and MAN4800 Series provides superior brightness in a choice of color LED displays. Standard units are available in red, green, orange and yellow, with common anode right hand decimal, common cathode right hand decimal, and universal (CA or CC) overflow (±1) with right hand decimal. They can be mounted in arrays with 0.400-inch (10.16 mm) center to center spacing. The green and yellow units are standard with a high minimum brightness and high ambient light package design.

MODEL NUMBERS

PART NO.	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN-OUT SPECIFICATION
MAN4505	Green	Universal (CA or CD) Overflow ±1, Rt. Hand Dec.	В	D
MAN4510	Green	Common Anode; Right Hand Decimal	Ā	Δ
MAN4540	Green	Common Cathode; Right Hand Decimal	Ä	Ĉ
MAN4605	Orange	Universal (CA or CD) Overflow ±1, Rt, Hand Dec.	R	Ď
MAN4610	Orange	Common Anode; Right Hand Decimal	Δ	Δ
MAN4630	Orange	Common Anode; Overflow ±1, Rt. Hand Dec.	Ê	B
MAN4640	Orange	Common Cathode; Right Hand Decimal	Δ	Č
MAN4705	Red	Universal (CA or CD) Overflow ±1, Rt. Hand Dec.	G C	0
MAN4710	Red	Common Anode; Right Hand Decimal	^	۸
MAN4740	Red	Common Cathode; Right Hand Decimal	~	Č
MAN4805	Yellow	Universal (CA or CD) Overflow ±1, Rt. Hand Dec.	Ä	, C
MAN4810	Yellow	Common Anode; Right Hand Decimal	^	•
MAN4840	Yellow	Common Cathode: Right Hand Decimal	A A	Č

	CTRO-OPTICAL CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
	Luminous intensity, Digit Average (See Note 1) Decimal point (See Note 3) Segment "C" or "D" of MAN4505	320 150 150	565		μcd μcd nm	I _F = 10 mA I _F = 10 mA
MAN4505/4510/4540	Peak emission wavelength Forward voltage Segment Decimal point		2.5 2.5	3.0 3.0	V	I _F = 20 mA I _F = 20 mA
005/45	Dynamic resistance Segment Decimal point		17 17		Ω	I _F = 20 mA I _F = 20 mA
MAN	Capacitance Segment Decimal point		35 35		pF pF	V = 0 V = 0
	Reverse current Segment Decimal point			100 100	μΑ μΑ	V _R = 5.0 V V _R = 5.0 V
MAN4605/4610/4630*/4640	Luminous intensity, Digit Average (See Note 1) Decimal point (See Note 3) Segment "C" or "D" of MAN4630 or 4605 Peak emission wavelength	510 250 250	630		μcd μcd μcd nm	I _F = 10 mA I _F = 10 mA I _F = 10 mA
/4630*	Forward voltage Segment Decimal point		2.2 2.2	2.5 2.5	V	I _F = 20 mA I _F = 20 mA
5/4610	Dynamic resistance Segment Decimal point		26 26		Ω	I _F = 20 mA I _F = 20 mA
N460	Capacitance Segment Decimal point		35 35		pF pF	V = 0 V = 0
W/	Reverse current Segment Decimal point			100 100	μΑ μΑ	V _R = 5.0 V V _R = 5.0 V
0	Luminous intensity, Digit Average (See Note 1) Decimal point (See Note 3) Segment "C" or "D" of MAN4705 Peak emission wavelength	200 85 85	660		μcd μcd nm	I _F = 10 mA I _F = 10 mA
MAN4705/4710/4740	Forward voltage Segment Decimal point		1.6 1.6	2.0 2.0	V	I _F = 20 mA I _F = 20 mA
705/47	Dynamic resistance Segment Decimal point		2 2		Ω	I _{PK} = 100 mA I _{PK} = 100 mA
MAN4	Capacitance Segment Decimal point		35 35	80 80		V = 0 V = 0
	Reverse current Segment Decimal point			100 100	μΑ μΑ	V = 5.0 V V = 5.0 V
9	Luminous intensity, Digit Average (See Note 1) Decimal point (See Note 3) Segment "C" or "D" of MAN4805 Peak emission wavelength	510 250 250	585		μcd μcd nm	I _F = 10 mA I _F = 10 mA
MAN4805/4810/4840	Forward voltage Segment Decimal point		2.5 2.5	3.0 3.0	V	I _F = 20 mA I _F = 20 mA
805/48	Dynamic resistance Segment Decimal point		26 26		Ω	I _F = 20 mA I _F = 20 mA
MAN4	Capacitance Segment Decimal point		35 35		pF pF	V = 0 V = 0
	Reverse current Segment Decimal point			100 100	μΑ μΑ	V _R = 5.0 V V _R = 5.0 V

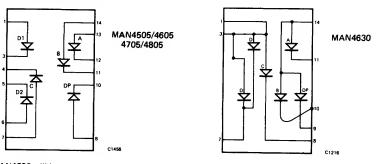
^{*}The MAN4630 should be replaced by the MAN4605 for new design-ins.



PIN CONNECTIONS

N CONNECT	(7.6; ±.0		.005" DIA (1.40mm) TDLERA (1.40mm) .055" DIA (1.40mm) .016" L.010" L.010" L.010" L.010" L.015" PART ND (4.06mm) L.015" PART ND	XX = PART ND. ATE CDDE T INTENSITY
IN COMMECT	TIONS			
PIN NO. MAN	A N4510/4610/4710/4810	B MANAGOON	С	D
1 (Cathode A	MAN4630* Anode C, D	MAN4540/4640/4740/4840 Anode F	MAN4505/4605/4705/4805 Anode D1
	Cathode F	No Pin	Anode G	No Pin
	Common Anode No Pin	Anode C, D	No Pin	Cathode D1
	No Pin	No Pin No Pin	Common Cathode No Pin	Cathode C
6 1	NC	NC	Anode E	Cathode D2 Anode D2
	Cathode E	Cathode D	Anode D	Anode D2 Anode C
	Cathode D	Cathode C	Anode C	Anode DP
	Cathode DP Cathode C	Cathode DP	Anode DP	No Pin
	Cathode G	Cathode B Cathode A	No Pin NC	Cathode DP
12 N	No Pin	No Pin	Common Cathode	Cathode B Cathode A
	Cathode B	No Pin	Anode B	Anode A
14 C	Common Anode	Anode A, B, & DP	Anode A	Anode B
ECTRICAL S	SCHEMATIC 14 MAN4508 4705/4		MAN4630	4605 instead.

ELECTRICAL SCHEMATIC



^{*}The MAN4630 will be available on an order only basis beginning 6/30/79. New designs should use the MAN4605 instead.

TYPICAL CURVES

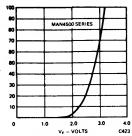


Fig. 1. Forward Current vs. Forward Voltage

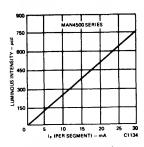


Fig. 2. Luminous Intensity vs. Forward Current

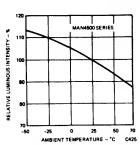


Fig. 3. Luminous Intensity vs. Temperature

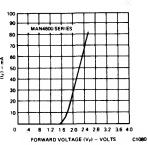


Fig. 4. Forward Current vs. Forward Voltage

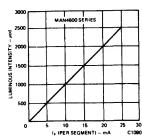


Fig. 5. Luminous Intensity vs. Forward Current

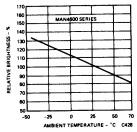


Fig. 6. Luminous Intensity vs. Temperature

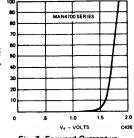


Fig. 7. Forward Current vs. Forward Voltage

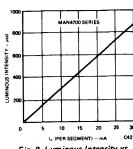


Fig. 8. Luminous Intensity vs. Forward Current

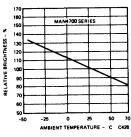


Fig. 9. Luminous Intensity vs. Temperature

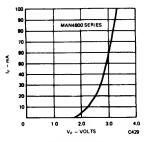


Fig. 10. Forward Current vs. Forward Voltage

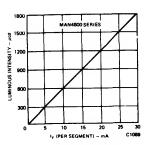


Fig. 11. Luminous Intensity vs. Forward Current

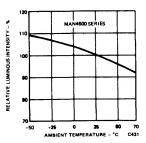


Fig. 12. Luminous Intensity vs. Temperature

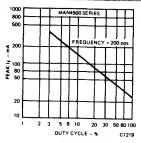


Fig. 13. Max Peek Current vs. Duty Cycle

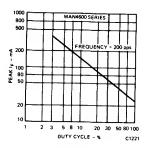


Fig. 15. Max Peak Current vs. Duty Cycle

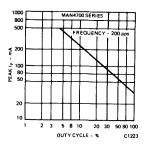


Fig. 17. Max Peak Current vs. Duty Cycle

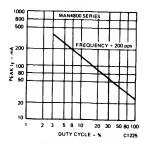


Fig. 19. Mex Peek Current vs. Duty Cycle

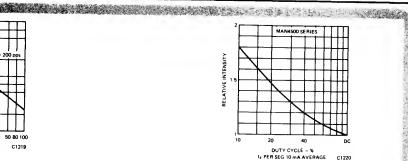


Fig. 14. Luminous Intensity vs. Duty Cycle

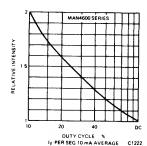


Fig. 16. Luminous Intensity vs. Duty Cycle

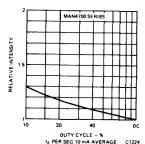


Fig. 18. Luminous Intensity vs. Duty Cycle

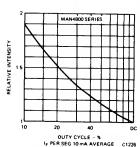


Fig. 20. Luminous Intensity vs. Duty Cycle

MINING AND APPLICATION OF THE PROPERTY OF THE

114MAN4500 MAN4600 MAN4700 MAN4800 SERIES

ABSOLUTE MAXIMUM RATINGS	MAN4505	MAN4510 MAN4540	MAN4705	MAN4710 MAN4740
Power dissipation @ 25°C ambient Derate linearly from 50°C	360 mW	480 mW	360 mW	480 mW
	-7.2 mW/°C	-9.6 mW/°C	-5.2 mW/°C	-6.9 mW/°C
	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C
Continuous forward current Total Per segment Decimal point	120 mA	160 mA	180 mA	240 mA
	20 mA	20 mA	30 mA	30 mA
	20 mA	20 mA	30 mA	30 mA
Reverse voltage Per segment	6.0 V	6.0 V	6.0 V	6.0 V
	6.0 V	6.0 V	6.0 V	6.0 V
	5 sec.	5 sec.	5 sec.	5 sec.
	MAN4805	MAN4810 MAN4840	MAN4605 MAN4630	MAN4610 MAN4640
Power dissipation @ 25°C ambient Derate linearly from 25°C	450 mW	600 mW	450 mW	600 mW
	-7.7 mW/°C	-10.3 mW/°C	-6.4 mW/°C	-8.6 mW/°C
	-40° to +85°C	-40°C to +85°C	-40° to +85°C	-40° to +85°C
Storage and operating temperature	-40 to 165 C	-40 0 10 .00 0		
Storage and operating temperature Continuous forward current Total	150 mA	200 mA	180 mA	240 mA
	25 mA	25 mA	30 mA	30 mA
	25 mA	25 mA	30 mA	30 mA

RECOMMENDED FILTERS

For optimum on and off contrast, one of the following filters or equivalents should be used over the display:

DEVICE TYPE	FILTER	DEVICE TYPE	FILTER
MAN4505 MAN4510 MAN4540	Panelgraphic Green 48	MAN4705) MAN4710) MAN4740)	Panelgraphic Red 60 Homalite 100-1605
MAN4605 MAN4610 MAN4630 MAN4640	Panelgraphic Scarlet 65 Homalite 100-1670	MAN4805) MAN4810) MAN4840)	Panelgraphic Yellow 25 or Amber 23 Homalite 100-1720 or 100-1726

NOTE: When using the grey face MAN4500 or MAN4800 series in situations of high ambient light, a neutral density filter can be used to achieve a greater contrast. The following or equivalent can be used: Panelgraphic Grey 10.

TYPICAL THERMAL CHARACTERISTICS

GREEN/YELLOW

Thermal resistance junction to free air Φ_{JA} ... 160° C/W Wavelength temperature coefficient (case temp) 1.0 Å/° C Forward voltage temperature coefficient ... -1.5 mV/° C

RED/ORANGE

Thermal resistance junction to free air Φ_{JA} . . . 160° C/W Wavelength temperature coefficient (case temp)1.0 Å/°C Forward voltage temperature coefficient . . . -2.0 mV/°C

NOTES

- 1. The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments as measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D), Intensity will not vary more than ±33.3% between all segments within a digit.
- 2. The curve in Fig. 3, 6, 9, and 12 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. The decimal point is designed to have the same surface brightness as the segments; therefore, the luminous intensity of the decimal point is .3 times the luminous intensity of the segments, since the area of the decimal point is .3 times the area of the average segment.
- 4. Leads of the device immersed to 1/16-inches from the body. Maximum device surface temperature is 140°C.
- 5. For flux removal, Freon TF, Freon TE, Isoproponal or water, may be used up to their boiling points.
- 6. All displays are categorized for luminous intensity. The intensity category is marked on each part as a suffex letter to the part number.

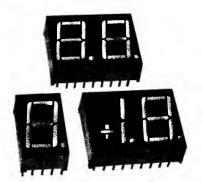
GENERAL INSTRUMENT
Optoelectronics

MAN6600 SERIES

0.560" ORANGE HIGH PERFORMANCE DISPLAY

DESCRIPTION

The MAN6600 Series is a family of large digits which includes double and single digits. The series features the sculptured font which minimizes "gappiness" at the segment intersections. Available models include two-digit, one and one-half digits with polarity sign, and single digits. All models have right hand decimal point and are available in common anode or common cathode configuration.



FEATURES

- High performance nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for luminous intensity (see note 6)
- Wide angle viewing . . . 150°
- Low forward voltage
- Two-digit package simplifies alignment & assembly

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point-of-sale equipment
- Digital clocks
- TV and radios

MODEL NUMBERS

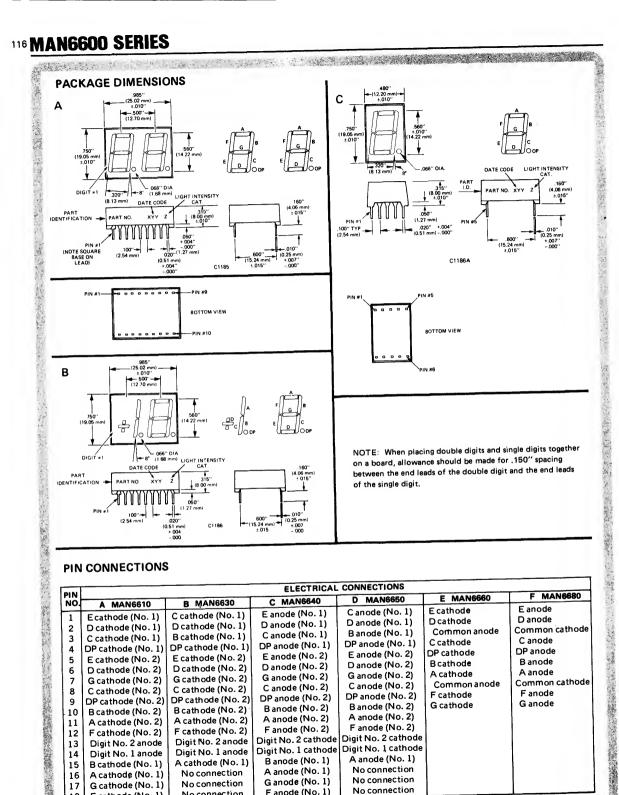
PART NO. MAN6610 MAN6630 MAN6640 MAN6650 MAN6660 MAN6680	COLOR Orange Orange Orange Orange Orange Orange	DESCRIPTION 2 Digit; Common Anode; Rt. Hand Decimal 1½ Digit; Common Anode; Overflow ±1.8. Rt. Hand Decimal 2 Digit; Common Cathode; Rt. Hand Decimal 1½ Digit; Common Cathode; Overflow ±1.8. Rt. Hand Decimal Single Digit; Common Anode; Rt. Hand Decimal Single Digit; Common Cathodo Rt. Hand Decimal	Α	PIN-OUT SPECIFICATION A B C D E
MAN6680	Orange	Single Digit; Common Cathode; Rt. Hand Decimal	C	F

FILTER RECOMMENDATIONS

For optimum on and off contrast, one of the following filters or equivalents should be used over the display:

MAN6600 Series

Panelgraphic Scarlet 65 Homalite 100-1670



PIN CONNECTIONS

	ELECTRICAL CONNECTIONS						
PIN NO	A MAN6610 B MAN6630	C MAN6640	D MAN6650	E MAN6660	F MAN6680		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	cathode (No. 1) cathode (No. 2) cathode (No. 1) cathode (No. 2) cathode (No. 2	E anode (No. 1) D anode (No. 1) C anode (No. 1) D anode (No. 2) D anode (No. 2) C anode (No. 2) C anode (No. 2) D anode (No. 2) A anode (No. 2) F anode (No. 2) D anode (No. 2) A anode (No. 2) D anode (No. 2) A anode (No. 2) D anode (No. 2) A anode (No. 1) A anode (No. 1) G anode (No. 1)	C anode (No. 1) D anode (No. 1) B anode (No. 1) DP anode (No. 2) D anode (No. 2) G anode (No. 2) C anode (No. 2) DP anode (No. 2) D anode (No. 2) A anode (No. 2) A anode (No. 2) F anode (No. 2) Digit No. 2 cathode Digit No. 1 cathode A anode (No. 1) No connection No connection	E cathode D cathode Common anode C cathode DP cathode B cathode A cathode Common anode F cathode G cathode	E anode D anode Common cathod C anode DP anode B anode A anode Common cathod F anode G anode		

ABSOLUTE MAXIMUM RATINGS

Power dissipation @ 25°C ambient Derate linearly from 50°C	MAN6610	MAN6630	MAN6660
	MAN6640	MAN6650	MAN6680
	1200 mW	1050 mW	600 mW
	-17.1 mW/°C	-15.0 mW/°C	-8.6 mW/°C
	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C
Total. Per segment	480 mA	420 mA	240 mA
	30 mA	30 mA	30 mA
	30 mA	30 mA	30 mA
Per segment	6.0 V	6.0 V	6.0 V
	6.0 V	6.0 V	6.0 V
	5 sec.	5 sec.	5 sec.

ELECTRICAL-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

Luminaus Interests - Dr. 11	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, Digit Average					
(see Note 1)	510			ucd	l = 10 0
Decimal point (see Note 5)	200			μcd	I _F = 10 mA
Segment C or D of "+" (6630/6650)	200			μcd	I _F = 10 mA
Peak emission wavelength	200	630		μcd	$I_F = 10 \text{ mA}$
Spectral line half width		630			
Forward voltage		40			
Segment					
Decimal point			2.5	V	$I_F = 20 \text{ mA}$
Dynamic resistance			2.5	V	I _F = 20 mA
					·F 201117
Segment		26		Ω	1 - 20 m A
Decimal point		26		$\tilde{\Omega}$	I _F = 20 mA
Capacitance				26	$I_F = 20 \text{ mA}$
Segment		35			
. Decimal point		35		pF	V = 0
Reverse current		35		pF	V = 0
Segment					
Decimal point			100	μΑ	$V_{R} = 3.0 \ V$
			100	μΑ	V _R = 3.0 V
Ratio I			2:1	·_	I _E = 10 mA

TYPICAL THERMAL CHARACTERISTICS

Thermal resistance junction to free air Θ_{JA}	1.500 0 0
Travelength temperature coefficient (case temp)	. 160 C/W
	. 1.0 A/C

NOTES

- 1. The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments. As measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than ±33.3% between all segments within a digit.
- 2. The curve in Fig. 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. Leads immersed to 1/16" from the body of the device. Maximum unit surface temperature is 140°C.
- 4. For flux removal, use Freon TF, Freon TE, Isoproponal, or water up to their boiling points.
- 5. Intensity adjusted for smaller areas of the "+" and decimal points.
- 6. All displays are categorized for luminous intensity. The intensity category is marked on each part as a suffix letter to the part number.

TYPICAL CURVES

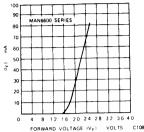


Fig. 1. Forward Current vs. Forward Voltage

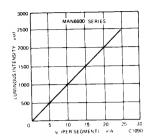
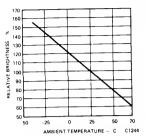


Fig. 2. Luminous Intensity vs. Forward Current



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Fig. 3. Luminous Intensity vs. Temperature (see Note 2)

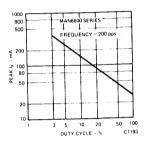


Fig. 4. Max Peak Current vs. Duty Cycle

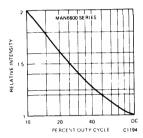
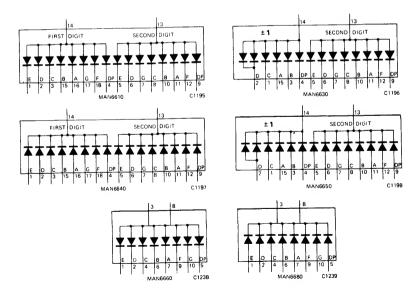


Fig. 5. Luminous Intensity vs. Duty Cycle

The state of the second of the

INTERNAL CONNECTIONS



GENERAL INSTRUMENT Optoelectronics

MAN6700 SERIES

0.560" RED HIGH PERFORMANCE DISPLAY

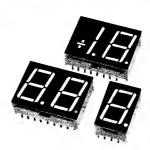
FEATURES

- High performance GaAsP
- Large, easy to read digits
- Common anode or common cathode models

- Also available in orange (MAN6600 Series)
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for luminous intensity (see note 7)
- Wide angle viewing . . . 150°
- Standard double-dip lead configuration
- Low forward voltage
- Two-digit package simplifies alignment & assembly

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point-of-sale equipment
- Digital clocks
- TV and radios



DESCRIPTION

The MAN6700 Series is a family of large digits which includes double and single digits. The series features the sculptured font which minimizes "gappiness" at the segment intersections. Available models include two-digit, one and one-half digits with polarity sign, and single digits. All models have right hand decimal point and are available in common anode or common cathode configuration.

MODEL NUMBERS

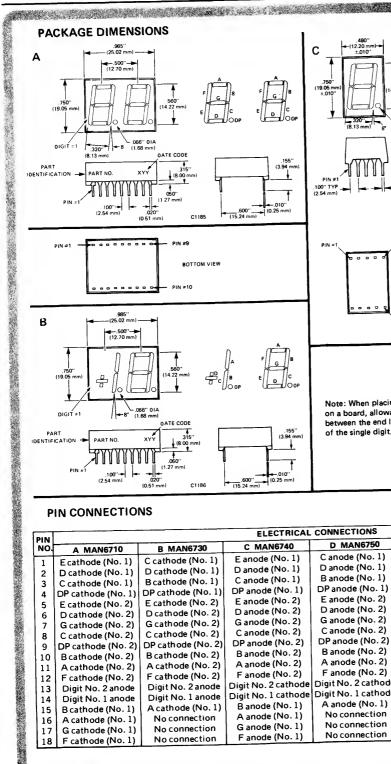
PART NO.	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN-OUT SPECIFICATION
MAN6710	Red	2 Digit; Common Anode; Rt. Hand Decimal	Α	Δ
MAN6730	Red	1½ Digit; Common Anode; Overflow ±1.8 Rt. Hand Decimal	R	6
MAN6740	Red	2 Digit; Common Cathode; Rt. Hand Decimal	A	Č
MAN6750	Red	1½ Digit; Common Cathode; Overflow ±1.8 Rt. Hand Decimal	B	
MAN6760	Red	Single Digit; Common Anode; Rt. Hand Decimal		D
MAN6780	Red	Single Digit; Common Cathode: Rt. Hand Decimal	C	- -

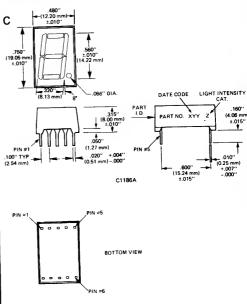
FILTER RECOMMENDATIONS

For optimum on and off contrast, one of the following filters or equivalents should be used over the display:

MAN6700 Series

Panelgraphic Red 60 Homalite 100 - 1605





Note: When placing double digits and single digits together on a board, allowance should be made for .150" spacing between the end leads of the double digit and the end leads of the single digit.

PIN CONNECTIONS

<u></u>	ELECTRICAL CONNECTIONS						
PIN NO.		B MAN6730	C MAN6740	D MAN6750	E MAN6760	F MAN6780	
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Ecathode (No. 1) D cathode (No. 1) C cathode (No. 1) D cathode (No. 1) E cathode (No. 2) G cathode (No. 2) G cathode (No. 2) C cathode (No. 2) D cathode (No. 2) B cathode (No. 2) B cathode (No. 2) F cathode (No. 2) F cathode (No. 2) F cathode (No. 2) F cathode (No. 2) Digit No. 1 anode B cathode (No. 1) A cathode (No. 1) G cathode (No. 1)	C cathode (No. 1) D cathode (No. 1) B cathode (No. 1) DP cathode (No. 2) D cathode (No. 2) C cathode (No. 2) C cathode (No. 2) C cathode (No. 2) DP cathode (No. 2) B cathode (No. 2) A cathode (No. 2) F cathode (No. 2) F cathode (No. 2) Digit No. 2 anode Digit No. 1 anode A cathode (No. 1) No connection	B anode (No. 2) A anode (No. 2) F anode (No. 2) Digit No. 2 cathode	C anode (No. 1) D anode (No. 1) B anode (No. 1) DP anode (No. 2) D anode (No. 2) G anode (No. 2) C anode (No. 2) DP anode (No. 2) DP anode (No. 2) B anode (No. 2) A anode (No. 2) F anode (No. 2) G anode (No. 2) A anode (No. 2) Digit No. 1 cathode A anode (No. 1) No connection No connection	E cathode D cathode C cathode D cathode DP cathode B cathode A cathode C common anode F cathode G cathode	E anode D anode Common cathode C anode DP anode B anode A anode Common cathode F anode G anode	

____.600" (15.24 m

C1186

ABSOLUTE MAXIMUM RATINGS

MAN6700	MAN6710	MAN6730	MAN6760
	MAN6740	MAN6750	MAN6780
Power dissipation @ 25°C ambient Derate linearly from 50°C	960 mW	840 mW	480 mW
	-13.7 mW/°C	-12.0 mW/°C	-6.9 mW/°C
	-40°C _\ to +85°C	-40°C to +85°C	-40°C to +85°C
Total Per segment Decimal point Reverse voltage	480 mA	420 mA	240 mA
	30 mA	30 mA	30 mA
	30 mA	30 mA	30 mA
Per segment	6.0 V	6.0 V	6.0 V
	6.0 V	6.0 V	6.0 V
	5 sec.	5 sec.	5 sec.

ELECTRICAL-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous intensity, Digit Average (see Note 1)	125			μcd	I _F = 10 mA
Decimal point (see Note 5)	55			μcd	I _E = 10 mA
Segment C or D of "+" (6730/6750) (note 5)	35			μcd	
Peak emission wavelength		650		nm	I _F = 10 mA
Spectral line half width		20			
Forward voltage		20		nm	
Segment			2.0		
Decimal point			2.0	V	I _F = 20 mA
Dynamic resistance			2.0	V	I _F = 20 mA
Segment		2			
Decimal point		2 2		$\boldsymbol{\sigma}$	1 _{PK} = 100 mA
Capacitance		2		Ω	1PK = 100 mA
Segment		35		_	
Decimal point		35 35		pF	V = 0
Reverse current		35		pF	V = 0
Segment					
Decimal point			100	μΑ	V _R = 5.0 V
Dodnia point			100	μΑ	V _R = 5.0 V
Segment C or D of "+" (6730/6750)			100	μΑ	V _R = 5.0 V

TYPICAL THERMAL CHARACTERISTICS

	160° C /M
Navelength temperature coefficient (case temp.)	160 C/W
England and the state of the st	3.0 Å/°C
Forward voltage temperature coefficient	_2 0 m\//° C

NOTES

- The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing the total number of segments as measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than ±33.3% between all segments within a digit.
- The curve in Fig. 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. Leads immersed to 1/16" from the body of the device. Maximum unit surface temperature is 140°C.

- 4. For flux removal, use Freon TF, Freon TE, Isoproponal, or water up to their boiling points.
- 5. Intensity adjusted for smaller areas of the "+" and decimal points.
- 6. Pins 3 and 8 on MAN6760 and MAN6780 are redundant anodes or cathodes.
- All displays are categorized for luminous intensity. The intensity category is marked on each part as a suffix letter to the part number.

TYPICAL CURVES

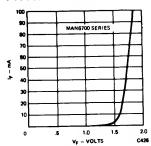


Fig. 1. Forward Current vs. Forward Voltage

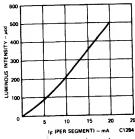


Fig. 2. Luminous Intensity vs. Forward Current

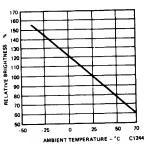


Fig. 3. Luminous Intensity vs. Temperature (See Note 2)

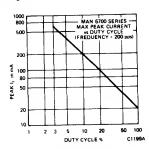


Fig. 4. Max Peak Current vs. Duty Cycle

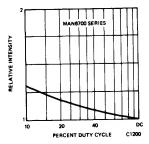
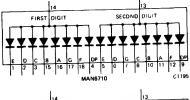
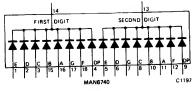
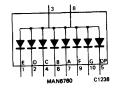


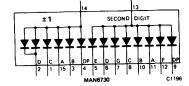
Fig. 5. Luminous Intensity vs. Duty Cycle

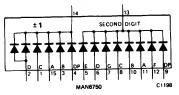
INTERNAL CONNECTIONS

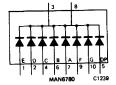












GENERAL INSTRUMENT Optoelectronics

MAN8600 SERIES 0.800" HIGH EFFICIENCY RED (ORANGE) HIGH PERFORMANCE DISPLAY

FEATURES

- High performance nitrogen-doped GaAsP on GaP
- Large, easy to read, digits
- Common anode or common cathode models
- Fast switching—excellent for multiplexing
- Low power consumption
- Bold solid segments that are highly legible
- Solid state reliability—long operation life
- Rugged plastic construction
- Directly compatible with integrated circuits
- High brightness with high contrast
- Categorized for luminous intensity (see note 6)
- Wide angle viewing . . . 150°
- Low forward voltage
- Gray face for use in high ambient light conditions

For industrial and consumer applications such as:

- Digital readout displays
- Instrument panels
- Point-of-sale equipment
- Digital clocks
- TV and radios



DESCRIPTION

The MAN8600 Series is a family of large digits 0.8 inches in height. This series combines high brightness large size and good aesthetics and is designed to be used where accurate readable displays need to be viewed over a distance. All models use right hand decimal points.

MODEL NUMBERS

PART NO.	COLOR	DESCRIPTION	PACKAGE DRAWING	PIN-OUT SPECIFICATION
MAN8610	Hi-Efficiency Red (Orange)	Common Anode, Right Hand Decimal Pt.	В	Α
MAN8630	Hi-Efficiency Red (Orange)	Common Anode, ± 1 Overflow, Right Hand Decimal Pt.	Α	В
MAN8640	Hi-Efficiency Red (Orange)	Common Cathode, Right Hand Decimal Pt.	В	С
MAN8650	Hi-Efficiency Red (Orange)	Common Cathode, ± 1 Overflow,	Α	D

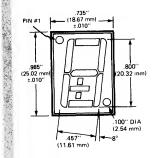
FILTER RECOMMENDATIONS

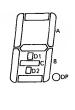
For optimum on and off contrast, one of the following filters should be used over the display:

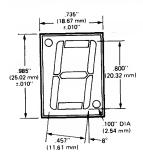
PANELGRAPHIC SCARLET 65 HOMALITE 100-1670 In situations of high ambient light, contrast with the gray face can be enhanced by using a neutral density filter. The following or an equivalent can be used:

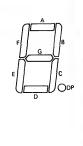
PANELGRAPHIC GREY NO. 10

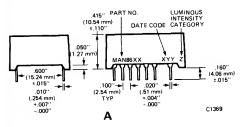
PACKAGE DIMENSIONS

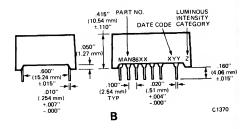












	ONNECTIONS	ELECTRICAL C	ONNECTIONS	
	Α	В	C MAN8640	D MAN8650
PIN#	MAN8610 No Connection	MAN8630 No Connection	No Connection	No Connection
1	A Cathode	No Connection	A Anode	No Connection No Connection
3	F Cathode	No Connection	F Anode	Common Catho
4	Common Anode	Common Anode	Common Cathode E Anode	C Anode
5	E Cathode	C Cathode	- Alloue	-
6	- Coshada	C Cathode	E Anode	C Anode
7 8	E Cathode	– Cathode	_	-
9	D Cathode	D2 Cathode	Common Cathode	Common Catho
10	DP Cathode	DP Cathode	DP Anode	DP Anode D2 Anode
11	D Cathode	D1 Cathode	D Anode	Common Catho
12	Common Anode	Common Anode	Common Cathode C Anode	B Anode
13	C Cathode	B Cathode	G Anode	D1 Anode
14	G Cathode	D2 Cathode A Cathode	B Anode	A Anode
15 16	B Cathode	A Cathode		
17	Common Anode	Common Anode	Common Cathode	Common Cathe
18	Common Amour		_	

TYPICAL CURVES

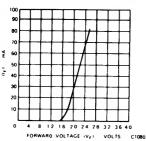


Fig. 1. Forward Current vs. Forward Voltage

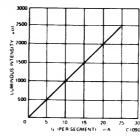


Fig. 2. Luminous Intensity vs. Forward Current

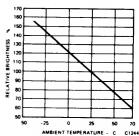


Fig. 3. Luminous Intensity vs. Temperature (see Note 2)

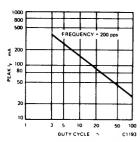


Fig. 4. Max Peak Current vs. Duty Cycle

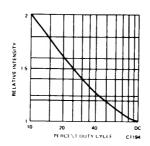


Fig. 5. Luminous Intensity vs. Duty Cycle

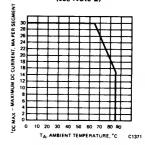
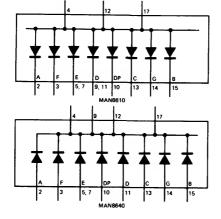
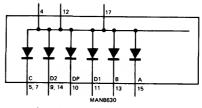
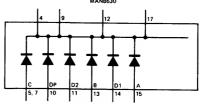


Fig. 6. Maximum DC Current vs. Temperature

INTERNAL CONNECTIONS







C1372

ABSOLUTE MAXIMUM RATINGS MAN8600	MAN8610 MAN8640	MAN8630 MAN8650
Power dissipation @ 25°C ambient	600 mW -8.6 mW/°C -40°C to +85°C	450 mW -6.4 mW/°C -40°C to +85°C
Continuous forward current Total Per segment Decimal point	240 mA 30 mA 30 mA	180 mA 30 mA 30 mA
Reverse voltage Per segment Decimal point Solder time @ 260°C (Note 4 and 5)	6.0 V 6.0 V 5 sec.	6.0 V 6.0 V 5 sec.

ELECTRICAL-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

ELECTRICAL-OFFICAL GHARACTE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Luminous Intensity, Digit Average (see Note 1) Decimal point (see Note 5) Segment C or D of "+" (8630/8650) Peak emission wavelength Spectral line half width	600 240 240	1000 400 400 630 40		μcd μcd μcd	I _F = 10 mA I _F = 10 mA I _F = 10 mA
Forward voltage Segment Decimal point			2.5 2.5	V V	I _F = 20 mA I _F = 20 mA
Dynamic resistance Segment Decimal point		26 26		Ω	I _F = 20 mA I _F = 20 mA
Capacitance Segment Decimal point		35 35		pF pF	V = 0
Reverse current Segment Decimal point Ratio I _L			100 100 2:1	μΑ μΑ –	$V_{R} = 3.0 \text{ V}$ $V_{R} = 3.0 \text{ V}$ $I_{F} = 10 \text{ mA}$

TYPICAL THERMAL CHARACTERISTICS

	100°CM
Т.	hermal resistance junction to free air Θ _{JA}
V	hermal resistance junction to tree air OJA
F	Vavelength temperature coefficient (case temp.)

NOTES

- 1. The digit average Luminous Intensity is obtained by summing the Luminous Intensity of each segment and dividing by the total number of segments as measured with a Photo Research Corp. "SPECTRA" Microcandela Meter (Model IV-D). Intensity will not vary more than ±33.3% between all segments within a digit.
- 2. The curve in Fig. 3 is normalized to the brightness at 25°C to indicate the relative efficiency over the operating temperature range.
- 3. Leads immersed to 1/16" from the body of the device. Maximum unit surface temperature is 140°C.
- 4. For flux removal, use Freon TF, Freon TE, Isoproponal, or water up to their boiling points.
- 5. Intensity adjusted for smaller areas of the "+" and decimal points.
- 6. All displays are categorized for luminous intensity. The intensity category is marked as a suffix letter to the part number.





GENERAL INSTRUMENT Optoelectronics

MMH SERIES RED MONOLITHIC LED DISPLAYS

FEATURES/DESCRIPTION

The MMH Series provides a selection of 7 segment, 9 segment, and 16 segment alpha-numeric fonts, with digit slants from 0 degrees to 12 degrees, as well as a bar chip and dot chip. These products offer high performance gallium arsenide phosphide red monolithic numeric, bar, and dot LED's and are particularly suited for watch, clock, toy and game displays. They are specifically designed for hybrid assembly operations

with automatic die attach and wire bonding operations in mind.

Monolithic numeric products are available in probed wafer form or mounted on expandable vinyl membranes for ease of handling and maintenance of dice adjacency, giving optimum digit-to-digit luminous intensity matching.

ELECTRICAL/OPTICAL CHARACTERISTICS

DESCRIPTION	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST COND	NOTES
Forward Voltage/Seg.	VF	1.55	_	1.80	Volts	I _E =10mADC	A
Reverse Voltage/Seg.	v _R	5.0	-	_	Volts	IR=100µADC	A
Luminous Intensity/Seg.	L.i.	67	l –	_	μcd	I _E =5mADC	A,B,F
Luminous Intensity/Seg.	L.I.	160*	_	_	μcd	I _E =10mADC	A,B,F
Luminous Intensity Ratio (Segment to Segment)	R _{LI} -1	-	- ,	1.5	-	I _F =10mADC	A,B,C,F
Luminous Intensity Ratio (Adjacent Dice)	R _{LI} -2	-	-	1.5	_	I _F =10mADC	A,B,D,F,G
Luminous Intensity Ratio (Five Adjacent Dice)	R _{LI} -3	-	-	1.8	_	I _F =10mADC	A,B,E,F,G
Peak Wave Length	λр	-	655	_	ηm	i _F =10mADC	

^{*}MMH322 = 250 µcd min.

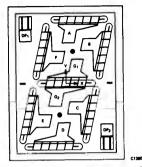
MECHANICAL CHARACTERISTICS

DIE TYPE	FONT	DIE SIZE (INCHES)	CHARACTER SIZE (INCHES)	CHARACTER SLANT	EMITTER WIDTH (IN)	NOMINAL BONDING PAD SIZE (IN)
MMH62M,W	7 seg.	0.048×0.036	0.042×0.022	12°	0.002	0.004x0.004
ММН75М	9 seg.	0.106x0,066	0.100×0.060	o°	0.005	Universal
MMH78M	9 seg.	0.082x0.052	0.075×0.045	o°	0.0055	Universal
ммн83м	9 seg.	0.106x0.066	0.100x0.060	プ	0.005	Universal
ммн66м	16 seg.	0.107x0.090	0.970×0.073	5°	0.0035	0.0065x0.0070
MMH80W	1 seg.	0.040x0,010	0.005×0.035	o°	0.005	0.004x0.0040
MMH321/2W,V	Dot	0.014x0.014	0.010x0.010	_	_	0.003 (DIA)

NOTE: See packaging note 3.

	MIN.	TYP.	MAX.	UNITS	NOTES
Cathode Metallization Au Alloy/Au — Thickness	3000	_	_	A	
Anode Metallization Aluminum — Thickness	8000	_	_	A	
Anode Bond Strength	3	_	_	Grams	н
Die Thickness — (Monolithic Digit) (Colon Dot)	=	0.007 0.0055	=	Inches Inches	

MECHANICAL CRITERIA — (Origin of X-Y coordinate system is located at the geometric center of the chip with the coordinate axes parallel to the edges of the chip.)



MMH62 5

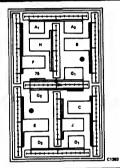
DIE SIZE CHARACTER SIZE

CHARACTER SLANT EMITTER WIDTH NOMINAL BONDING PAD SIZE 0.048" X 0.036" 0.040", Seg. A-Seg. D, &-& 0.01956", Seg. B-Seg. F, &-& 12"

0.002" 0.004" X 0.004"

BONDING PAD LOCATIONS

$X_A = 0.001"$	$Y_A = 0.0145''$
$\hat{x}_{B}^{A} = 0.007''$	$Y_{\rm R} = 0.012^{\circ}$
$\hat{X}_{C}^{B} = 0.0027''$	YC = -0.008"
	YD = -0.0145"
XD = -0.001" XE = -0.007"	YE = -0.012"
XF = -0.0027"	YE = 0.008"
	YG = 0.0055"
	$Y_{G_2}^{-1} = -0.0055''$
	YDF = 0.015"
$X_{DP_1}^{O2} = -0.0128''$ $X_{DP_2}^{O2} = 0.0128''$	YDP2 = -0.015"
ADP2 - 0.0120	. Dr2



MMH75

DIE SIZE CHARACTER SIZE

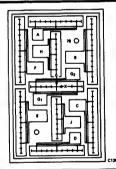
CHARACTER SLANT EMITTER WIDTH EMITTER LENGTH

NOMINAL BONDING PAD SIZE

0,106" X 0.066" 0.095", Seg. A-Seg. D, Ç-Ç-0.055", Seg. F-Seg. B, Ç-Ç-0" 0.006" 0.046", Seg. B, C, E, F 0.046", Seg. A, D, G 0.038", Seg. H, J Universal Chip

BONDING PAD LOCATIONS

$\begin{array}{lll} X_{A1} = -0.0132'' \pm 0.003'' \\ X_{B2}^{A2} = 0.0122'' \pm 0.004'' \\ X_{B2}^{A2} = 0.0143'' \pm 0.006'' \\ X_{C1} = -0.0122'' \pm 0.003'' \\ X_{D1} = -0.0122'' \pm 0.003'' \\ X_{C2}^{A2} = -0.0132'' \pm 0.003'' \\ X_{C2}^{A2} = -0.0133'' \pm 0.003'' \\ X_{C2}^{A2} = -0.0133'' \pm 0.003'' \end{array}$	$X_H^2 = -0.0117" \pm 0.005"$ $X_J = 0.0117" \pm 0.005"$ $Y_A = 0.0392" \pm 0.001"$ $Y_A^2 = 0.0392" \pm 0.001"$ $Y_B^2 = 0.0278" \pm 0.002"$	$Y_{D1} = -0.0392'' \pm 0.001''$ $Y_{D2} = -0.0392'' \pm 0.001''$ $Y_{E}^2 = -0.0278'' \pm 0.002''$ $Y_{F} = -0.0158'' \pm 0.002''$ $Y_{G1} = -0.0084'' \pm 0.001''$ $Y_{G2} = -0.0084'' \pm 0.001''$ $Y_{H2} = -0.0278'' \pm 0.002''$
$X_E^2 = -0.0143'' \pm 0.006''$ $X_E = -0.0153'' \pm 0.005''$	Y _B = 0.02/8" ± 0.002" Y _C = -0.0158" ± 0.002"	Y _J = -0.0278" ± 0.002"



MMH78

DIE SIZE CHARACTER SIZE

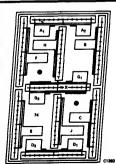
CHARACTER SLANT EMITTER WIDTH EMITTER LENGTH

NOMINAL BONDING PAD SIZE

0.082" X 0.052" 0.0895", Seg. A-Seg. D, Ç-Ç 0.0395", Seg. F-Seg. B, Ç-Ç 0°

0" 0.0055" 0.0365", Seg. B, C, E, F 0.030", Seg. A, D, G 0.024", Seg. H, J Universel Chip

BONDING PAD LOCATIONS



MMH83

DIE SIZE CHARACTER SIZE

CHARACTER SLANT EMITTER WIDTH EMITTER LENGTH

7-0.005" 0.049", Seg. B, C, E, F 0.046", Seg. A, D, G 0.038", Seg. H, J

0.106" X 0.066" 0.095", Seg. A-Seg. D, &-& 0.0548", Seg. F-Seg. B, &-&

NOMINAL BONDING PAD SIZE

BONDING PAD LOCATIONS

$\begin{array}{llllllllllllllllllllllllllllllllllll$	$\begin{array}{lll} X_{G1} = -0.0153'' \pm 0.003'' \\ X_{G2} = 0.0153'' \pm 0.003'' \\ X_{H2} = -0.0097'' \pm 0.006'' \\ X_{J} = 0.0097'' \pm 0.006'' \\ 1_{A1} = 0.0396'' \pm 0.001'' \\ Y_{A2} = 0.0395'' \pm 0.001'' \\ Y_{B2} = 0.0303'' \pm 0.001'' \\ Y_{C} = -0.0211'' \pm 0.001'' \end{array}$	$\begin{array}{lll} Y_{D1} = -0.0396'' \pm 0.001'' \\ Y_{D2} = -0.0396'' \pm 0.001'' \\ Y_{E} = -0.0303'' \pm 0.001'' \\ Y_{F} = 0.02211'' \pm 0.001'' \\ Y_{G1} = -0.0080'' \pm 0.001'' \\ Y_{G2} = 0.0080'' \pm 0.001'' \\ Y_{H} = 0.0303'' \pm 0.001'' \\ Y_{J} = -0.0303'' \pm 0.001'' \end{array}$
--	--	---

*Available after October 1, 1979.

MMH84* (Preliminary)

DIE SIZE CHARACTER SIZE

The second of th

CHARACTER SLANT EMITTER WIDTH NOMINAL BONDING PAD SIZE 0.085" X 0.072" 0.074", Seg. A-Seg. D, ငူ-ငူ. 0.0546", Seg. F-Seg. B, ငူ-ငူ. 5" 0.003"

.0055" X .0055"

BONDING PAD LOCATIONS:

X _{A1}	=	-0.0109	XG2 =	0.0139	YA1 =	0.305	YG2 =	0.0065
XA2	=	0.009	ΧH* =	0.0027	YA2 -	0.0305	ŸH =	0.0284
XB	=	0.0222	xj =	0.0027	YB* =	0.0127	Ϋ́́J =	0.0284
ΧČ	-	0.0194	XK =	0.0067	Yč =	0.0152	ÝK =	0.021
X _{D1}	-	0.009	X =	0.0144	YD1 =	0.0305	Ýì =	0.0072
X _{D2}	-	0.0109	XM -	0.0144	YD2 =	0.305	YM =	0.0072
XE	-	0.0222	XN =	0.0067	YE =	0.0127	YN =	0.021
XĒ	-	0.0194	XDP1 =	0.0089	YF =	0.0152	YDP1 =	0.0219
X _{G1}	•	0.0139	X _{DP2} =	0.0089	YG1 =	0.0065	YDP2 =	0.0219

ММН80

DIE SIZE
CHARACTER SIZE
CHARACTER SLANT
EMITTER WIDTH
EMITTER LENGTH
BONDING PAD SIZE
PAD LOCATION

0.040" X 0.010" 0.005" X 0.035" 0" 0.006" 0.035" 0.004" X 0.004" 0.000" X 0.000"

MMH321/2



DIE SIZE CHARACTER SIZE BONDING PAD SIZE

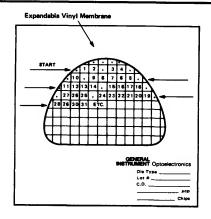
0.014" X 0.014" 0.010" X 0.010" 0.003" (DIA)

VISUAL CHARACTERISTICS	LIMIT	NOTE I, J	
1. Chips	None in active area.		
2. Cracks	None in active area.	K	
3. Missing, extraneous, or occluded emitting area	Not detectable to the unaided eye under light-up @ Iբ=10mADC.	A	
4. Emitter isolation	No emitters electrically shorted.	1	
5. P-contact metallization defects	No defect producing visual non-uniformity in any emitting area detectable by the unaided eye under light-up @ Ip=10mADC.	A	
6. Bonding pad defects	No defect prohibiting normally satisfactory wire bonding.		

NOTE: Supplemental visual characteristic drawings on request.

RECOMMENDED SEQUENCE FOR REMOVING DICE FROM EXPANDED MEMBRANE

In order to optimize digit to digit luminous intensity match, remove dice from expanded vinyl membrane in the sequence relative to wafer orientation on the membrane as shown in the drawing at right.



NOTES:

- A. The device under test must be die attached and wire bonded to the display substrate of intended use or on an 8-Pin, TO-5, Au-plated, Kovar header.
- B. Luminous intensity will be measured with a Photo-Research Spectra microcandela meter, Model IVD fitted with a 4° probe.
- C. RLI-1 is the ratio of brightest emitter divided by dimmest emitter within a die.
- D. R_{LI}-2 is the ratio of brightest emitter divided by dimmest emitter between packaged horizontally adjacent dice.
- E. RL1—3 is the ratio of brightest emitter divided by the dimmest emitter between five packaged horizontally adjacent dice.
- F. All correlation and reject verification must be done by electro-optic means such as monitoring the photo current from a silicon photodetector (C.I.E. corrected) or photomultiplier positioned such that the normal axis of the L.E.D. chip and the photodetector are coincident and that they be separated by at least two inches. The test must be conducted in a zero ambient light environment with device under test configuration as specified in Note A, above.
- G. In order to optimize digit to digit luminous intensity matching die should be removed from the vinyl film as shown in figure 1.
- H. The pull test shall be performed on a gold ball bond formed from 0.001 inch wire.
- I. A chip is defined to be any missing material around the edges of the die when viewed from the emitter side of the die.
- J. The active area consists of the areas defined by the emitters and p-contact metallization.
- K. A crack is defined to be any mechanical discontinuity of the surface other than etched steps.

PACKAGING/LABELING/SHIPPING CHARACTERISTICS

1) Monolithic Numerics and Colons

Wafers are mounted on 5.75" x 5.75" expandable vinyl membranes. Each wafer is covered by a 0.001" thick mylar overlay and separated from adjacent wafers by anti-static, non-adhesive spacers. Each mounted wafer is marked with the following information:

Die Type Lot Number

Number of Good Dice

Average Luminous Intensity

Control Date

Mounted wafers are packed in secondary cartons which ensure their integrity during shipment. Each secondary carton is marked with the following information:

Device Type/Part Number

Number of Good Dice Date Code

Lot Number

2) Watch Set Colons Standard packaging for discrete colons is a vial marked with the following information:

Die Type

Lot Number

Number of Good Dice

Luminous Intensity Category

Control Date

Colon dice are not visually sorted. The number of good dice supplied in a shipment corresponds to the ratio required for use with the monolithic digits. Colon dice are luminous intensity categorized for optimum match to the monolithic digits and are supplied in two standard categories to be used as follows:

3) Package Code Suffix

W = shipped in unscribed wafer form

M = scribed and mounted on expandable vinyl membrane

V = scribed and packaged in vials

GENERAL INSTRUMENT Optoelectronics

G-32 Y-32 O-32 GREEN, YELLOW AND ORANGE LED DICE

FEATURES/DESCRIPTION

The G, Y, O-32 Series is a light emitting diode fabricated from state-of-the-art Nitrogen doped GaAs_XP_{1-X} epitaxially grown on a GaP substrate. The device is a full chip emitter whose luminous performance has been optimized by using the current best epitaxial growth and die fabrication procedures currently available. The dice are shipped on expandable vinyl membranes for ease in handling and for maintenance of die adjacency which provides the user the best possible die-to-die hue and luminous intensity matching.

ELECTRICAL/OPTICAL CHARACTERIZATION (See Notes)

PARAMETER	PRODUCT	MIN	MAX	UNITS
Forward Voltage @ If = 20mA	G-32		2.6	Volts
	Y-32		2.6	7 0.123
	0-32		2.5	
Reverse Voltage @ I _r = 100μA	G-32	8	_	Volts
	Y-32	8		
	0-32	8	_	
Luminous Intensity at I _f = 20mA (unlensed)	G-32	200	-	μcd
	Y-32	700		,
	0-32	700		
Center Wavelength at I _f = 10mA	G-32	5600	5750	Angstroms
	Y-32	5750	5950	
	0-32	6250	6400	

PHYSICAL CHARACTERISTICS

Viewed from the top, the nominal 32 Series die is square measuring 0.0120 inches on a side at the top and 0.0140 inches on a side at the base. The nominal thickness of the die is 0.010 inches. In practice, the die dimensions do not deviate by more than 20% from the nominal values. The bottom of each die is metallized with a gold alloy which can be attached to conventional gold or silver plated substrates or lead frames by using a conductive epoxy.

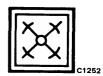
The top of each die is selectively metallized and the bonding pad material is compatible with conventional gold thermocompression and aluminum wire bonding techniques.

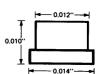
PACKAGING AND LABELING

32 Series wafers are mounted on 5.75" x 5.75" expandable vinyl membranes and covered with a thin protective overlay. Each wafer is clearly labeled identifying the die type, lot number, control date, brightness minimum and the number of die which meet the specifications.

Notes:

- Electricel end opticel cheracteristics are determined by die attaching and wire bonding the LED chip to e TO-18, Au plated, Kovar heeder. No encapsulation is
- Luminous intensity is meesured with a Photo-Research Spectre microcendela meter, Model IV-D, fitted with e 4° probe. The center wevelength is determined with e 0.5 meter Jerrell-Ash grating monochrometor and is defined es the average of the spectrum half power points.
- Package code suffix: W = shipped in unscribed wafer form
 M = scribed end mounted on expandeble vinyl membrene







	احمر				DETICION		اكيي	
ACTUAL SIZI	DI VICI NO.	OUTPUT CONFIGURATION	I MILLI R VOLTAGI	MIN. OUPEL VOLEVGE (BV _{CEO})	15 PIC 51	MAX. V(1/SAI)	MIN. CURRENT IRANSEUR RATIO	
	MCT2 MCT2E MCT26	TRANSISTOR	1.5V @ 20mA	30V	250 250 150	.4V @ 2mA .4V @ 2mA .5V @ 1.6mA	20% 20% 6%	
	мст210	TRANSISTOR	1.5V @ 40mA	30V	400	.4V @ 16mA	150%	
	MCT271 MCT272 MCT273 MCT274	TRANSISTOR	1.5V @ 20mA	30V	420 500 280 360	.4V @ 2mA	45-90% 75-150% 125-250% 225-400%	
	MCT275	TRANSISTOR	1.5V @ 20mA	80V	170	.4V @ 2mA	70-210%	
	MCT276 MCT277	TRANSISTOR	1.5V @ 20mA	30V	90 420	.4V @ 2mA	15-60% 100%-up	
	MCC670 MCC671	SPLIT-DARLINGTON	1.7 V @ 1.7mA	To 7V To 18V	-	0.4V \otimes I _f = 1.6mA, I _Q = 4.8mA V _{cc} = 4.5V 0.4V \otimes I _f = 5mA, I _Q = 15mA V _{cc} = 4.5V	300% 400%	
	MCT4 MCT4R	TRANSISTOR	1.5V @ 40mA	30V	-	.5V @ 2mA	15%	
	MCT6 MCT66	TRANSISTOR PAIR	1.5V @ 20mA	30V	-	.4V @ 2mA	20% 6%	
	4N25 4N26 4N27 4N28	TRANSISTOR	1.5V @ 50mA	30V	250	.5V @ 2mA	20% 20% 10% 10%	
	4N29 4N30 4N31 4N32 4N33	DARLINGTON TRANSISTOR	1.5V @ 50mA	30V	5000	1.0V @ 2mA 1.0V @ 2mA 1.2V @ 2mA 1.0V @ 2mA 1.0V @ 2mA	100% 100% 50% 500% 500%	
My	4N35 4N36 4N37	TRANSISTOR	1.5V @ 10mA	30V	100	.3V @ .5mA	100%	
	MCA230 MCA231 MCA255	DARLINGTON TRANSISTOR	1.5V @ 20mA	30V 30V 55V	25,000 50,000 25,000	1.0V @ 50mA 1.2V @ 50mA 1.0V @ 50mA	100% 200% 100%	
ACTUAL SIZE	DEVICE NO.	OUTPUT CONFIGURATION	FORWARD VOLTAGE	VGT	ON-VOLLAGE	HOLDING CURREN	i hi	
	MCS2 MCS2400	SCR	200V 400V	1V	1.3V @ 100mA	.5mA	14mA	
	MCS6200 MCS6201	BI-DIRECTIONAL SCR'S	200V	1V	1.3V @ 100mA	2mA	14mA	
ACTUAL SIZE	DEVICT NO.	OUTPUT CONFIGURATION	I MITH R VOLTAGE	211	t _{OHL}	H CTOR Voi	1((
	MCL601 MCL611	OPEN-COLLECTOR LOGIC GATE	1.5V @ 20mA	1mA	200µA	.4V @ 16mA	20mA	

MIN. DESURGE ISOLATION VOLEAGE	OPERATING SPEED OR BANDWIDTH	APPLICATIONS
1500V 3550V 1500V	150KHz 150KHz 300KHz	AC line/digital logic isolator, logic isolator, line receiver, cable receiver, relay monitor, power supply monitor, UL recognized.
2500V	150KHz	Digital logic isolation, line receiver feedback control, monitoring circuits in high isolation environments. UL recognized.
3550V	7µsec 10µsec 20µsec 25µsec	Switching networks, power supply regulators, digital logic inputs, microcircuit inputs, appliance sensor systems, appliance controls. UL recognized.
3550V	7µsec	Telecommunications, high voltage industrial control, relay driver, telephone. UL recognized.
3550V 2500V	2.5µsec 15µsec	Data processing, microprocessor input, high speed digital logic. UL recognized.
3000V	tPHL @ 10µsec tPLH @ 35µsec tPHL @ 1µsec tPLH @ 7µsec	CMOS logic interface, telephone ring detector, low input TTL interface, power supply isolation. UL recognized.
1000V	300KHz	Logic isolation, line or cable receiver for high hermeticity.
1500V	150KHz	Data line isolation, telephone signal coupling, line/cable receiver, mobil equipment.
2500V 1500V 1500V 500V	300KHz	Low cost products for logic isolator, telecommunications, line/cable receiver, high frequency feedback control system, monitoring circuits.
2500V 1500V 1500V 2500V 1500V	30KHz	Low capacitance medium speed products for data isolation, logic conversion, line/cable receiver, monitoring circuits, or mechanical feedback controls.
3550V 2500V 1500V	150KHz	Low current, low power products for industrial control and consumer, monitoring circuits, line receiver. UL recognized.
3550V	10KHz	High current, low capacitance and fast switching products for read relay, pulse transformer, multiple contact control applications. Telecommunication, remote control logic isolation & alarm monitoring circuits, AC line/logic coupling.
FMITH R VOLTAGI	MIN. ISOLATION VOLTAGI	APPLICATIONS
1.5V @ 20m A	2500V 3550V	Lower power IC's to AC line isolation, relay functions, latches for DC circuits, home appliances, consumer and industrial control logic. UL recognized.
1.5V @ 20mA	1500V 2500V	AC power control, triac triggering, AC motor control, power supply polarity control, appliance control, logic interface.
MIN. DESURGI ISOLATION VOLTAGE	MIN. OPERATING FREQUENCY	APPLICATIONS
2000V	1MHz	Digital logic isolator, DC voltage sensor, pulse shaping, level shifting, logical level conversion.

GENERAL INSTRUMENT Optoelectronics

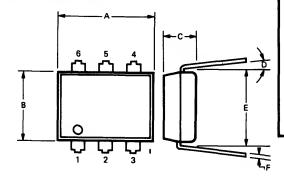
4N25 4N26

PHOTOTRANSISTOR OPTOISOLATORS

PRODUCT DESCRIPTION

The 4N25, 4N26, 4N27, and 4N28 series of optoisolators have an NPN silicon planar phototransistor optically coupled to a gallium arsenide diode. Each is mounted in a six-lead plastic DIP package.

PACKAGE DIMENSIONS

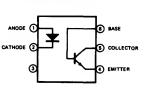


FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- Small package size and low cost
- High isolation voltage
- Excellent frequency response

	4	*	3	-1	+	,
SEATING PLANE	- Z	*[过	G
PLANE	P					
				<u>+</u> + +	- K	

PACKAGE MATERIALS: Leads - Tinned with 60/40 tin lead Body - Silicone plastic



SYMBOL	INCH MAX.	MM. MAX.	NOTES
Α	.365	9.27	
В	.270	6.73	
С	.130	3.18	
D	15°	15°	
Ε	.300 Ref	7.62 Ref	1
F	.014	0.36	l
G	.325	8.26	
н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
M N P	.175	4.45	3 4 3

NOTES

- Installed position of lead centers
- Four places
- Overall installed position
- These measurements are made from the seating plane

ABSOLUTE MAXIMUM RATINGS

*Storage temperature	-55°C to 150°C
*Operating temperature at junction	-55 6 10 150 6
*Operating temperature at junction	–55°C to 100°C
*Lead temperature (soldering, 10 sec)	260°C
*Total package power dissipation at 25°C ambient (LED plus detector)	200 0
Description of the control of the co	250 mw
*Derate linearly from 25°C	3.3 mW/°C

C1339

Input diode

*Forward DC current continuous	80 mA
*Reverse voltage	
*Peak forward current	
(300 μs, 2% duty cycle)	. 3.0 A
*Power dissipation at 25°C ambient 19	50 mW

*Derate linearly from 25°C 2.0 mW/°C

*Indicates JEDEC Registered Data.

Output transistor

tput transistor	
*Collector emitter voltage (BV _{CEO})3	v
*Collector base voltage (BV _{CBO})) V
*Emitter collector voltage (BV _{ECO})	7 V
*Power dissipation at 25°C ambient 150 i	nW
*Derate linearly from 25°C 2.0 mW	/°c

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

				GUAR.		TEST
CHARACTERISTICS	SYMBOL	MIN.	TYP.	MAX.	UNITS	CONDITIONS
Input diode						I _E = 50 mA
*Forward voltage	V _F		1.20	1.50	V	$V_R = 0 \text{ V, } f = 1 \text{ MHz}$
Capacitance	С		150	100	pr_	$V_R = 3.0 \text{ V}, R_L = 1.0 \text{ M}\Omega$
*Reverse leakage current			.05	100	μΑ	VR = 3.0 V, RL = 1.0 Mas
Output transistor						V - 5 V I - 500 "A
DC forward current gain	h _{FE}		250			$V_{CE} = 5 \text{ V, I}_{C} = 500 \mu\text{A}$
*Collector to emitter					.,	10m0 l =0
breakdown voltage	BV _{CEO}	30	6 5		V	$I_C = 1.0 \text{ mA}, I_B = 0$
*Collector to base						
breakdown voltage	BV _{CBO}	70	165		V	$I_C = 100 \mu A, I_E = 0$
*Emitter to collector						$I_{\rm E} = 100 \mu \text{A}, I_{\rm B} = 0$
breakdown voltage	BV _{ECO}	7	14		V	IE = 100 μΑ, IB = 0
*Collector to emitter leakage			2 5			V _{CE} = 10 V Base Open
current (4N25, 4N26, 4N27)	CEO		3.5	50	nΑ	ACE - 10 A Base Oben
*Collector to emitter leakage				100	nA	
current (4N28)				100	11/~	
*Collector to base			0.1	20	nΑ	V _{CB} = 10 V Emitter Open
leakage current	I _{CBO}		0.1	20	11/4	ACB - 10 A FINITE OPEN
Coupled						
*Collector output current (a)		2.0	5.0	_	~ Δ	$V_{CF} = 10 \text{ V}, I_{F} = 10 \text{ mA}, I_{B} = 0$
(4N25, 4N26)	Ι _C	2.0 1.0	3.0		111/	ACE TO A TE TO THE ATE
(4N27, 4N28)		1.0	3.0			
*Isolation voltage (b)	.,	2500		_	V	Peak
(4N25)	V_{ISO}	1500			v	Peak
(4N26, 4N27)		500		_	v	Peak
(4N28)		300	101	1	Ω	V = 500 VDC
Isolation resistance (b)	V (CAT)		0.2		,, V	I _C = 2.0 mA, I _F = 50 mA
*Collector-emitter saturation	V _{CE} (SAT)		1.3		ρF	C
Isolation capacitance (b)	ь		300		kHz	
Bandwidth (c)	B_W		300	,	KITZ	(Figure 12)
(also see note 2)						(, ,32,0 12)

*Indicates JEDEC Registered Data.

(a) Pulse Test: Pulse Width = 300 μ s, Duty Cycle \leq 2.0%

(b) For this test LED pins 1 and 2 are common and Phototransistor pins 4, 5 and 6 are common.

(c) If adjusted to yield I $_{\rm C}$ = 2 mA and i $_{\rm c}$ = 0.7 mA RMS; Bandwidth referenced to 10 kHz.

SWITCHING TIMES		TYP.	UNITS	TEST CONDITIONS
Non-saturated				
Collector				
Delay time	t _a	0.5	μs	$R_L = 100 \Omega$, $I_C = 2 mA$, $V_{CC} = 10 V$
Rise time	t."	2.5	μs	(Fig. 7 and 13)
Fall time	t.	2.6	μs	
Non-saturated	70			
Collector				
Delay time	t.	2.0	μs	$R_1 = 1k\Omega$, $I_C 2 mA$, $V_{CC} = 10 V$
Rise time	t d	15	μs	(Fig. 7 and 13)
Fall time	+	15	μs	(
	4		,	
Saturated	i (CAT)	5	μs	$R_1 = 2k\Omega$, $I_F = 15$ mA, $V_{CC} = 5$ V
t _{on} (from 5 V to 0.8 V)	t _{on} (SAT)		•	R _B = Open (Circuit No. 1)
t _{off} (from SAT to 2.0 V)	toff (SAT)	25	μs	RB - Open (Circuit (10: 1)
Saturated		_		D = 01.0 1 = 20 m/s V = 5 V
t _{on} (from 5 V to 0.8 V)	t _{on} (SAT)	5	μs	$R_L = 2k\Omega$, $I_F = 20 \text{ mA}$, $V_{CC} = 5 \text{ V}$
toff (from SAT to 2.0 V)	t _{off} (SAT)	18	μs	$R_B^L = 100k\Omega$ (Circuit No. 1)
Non-saturated	•			
Base — Collector photo diode				
Rise time	t,	175	ns	$R_L = 1k\Omega$, $V_{CB} = 10 V$
Fall time	ť.	175	ns	

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

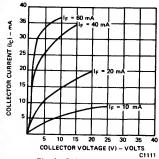


Fig. 1. Collector Current vs. Collector Voltage

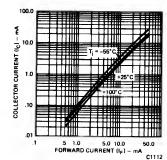
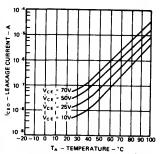


Fig. 2. Collector Current vs. Forward Current



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Fig. 3. Dark Current vs. Temperature

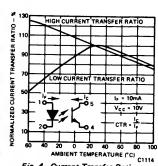


Fig. 4. Current Transfer Ratio vs. Temperature

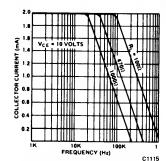


Fig. 5. Collector Current vs. Frequency (see Fig. 12 for circuit)

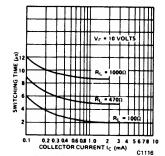
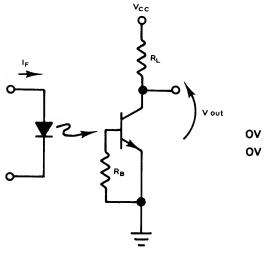


Fig. 6. Switching Time vs. Collector Current (see Fig. 13 for Circuit)

C1117



C1110

Circuit 1

Fig. 7. Pulse Test Definition (Note 3)

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (Cont'd)

(25°C Free Air Temperature Unless Otherwise Specified)

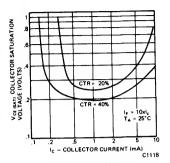


Fig. 8. Saturation Voltage vs. Collector Current

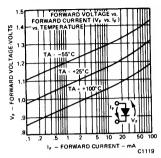
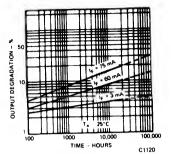


Fig. 9. Forward Voltage vs. Forward Current



The Mangaran at the fire

Fig. 10. Lifetime vs. Forward Current

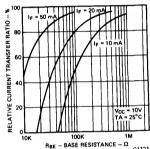


Fig. 11. Sensitivity vs. Base Resistance

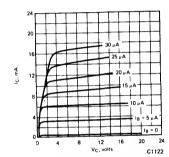


Fig. 12. Detector hfe Curves

OPERATING SCHEMATICS

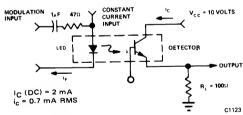


Fig. 13. Modulation Circuit Used to Obtain Output vs. Frequency Plot

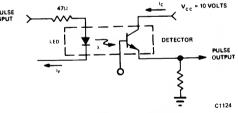


Fig. 14. Circuit Used to Obtain Switching Time vs. Collector Current Plot

Lie William . The will see the

NOTES

- 1. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.
- 2. The frequency at which $i_{\rm C}$ is 3dB down from the 10 kHz value.
- Rise time (t_r) is the time required for the collector current to increase from 10% of its final value to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

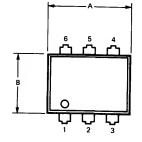
GENERAL INSTRUMENT Optoelectronics

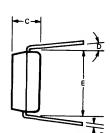
4N29 4N30 4N31 4N32 4N33 PHOTO-DARLINGTON OPTOISOLAT

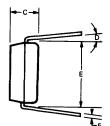
PRODUCT DESCRIPTION

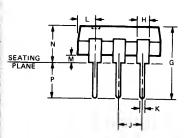
The 4N29, 4N30, 4N31, 4N32 and 4N33 have a gallium arsenide infrared emitter optically coupled to a silicon planar photo-darlington. Each unit is sealed in a 6-lead plastic DIP package.

PACKAGE DIMENSIONS

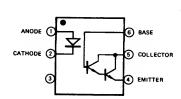








PACKAGE MATERIALS: Leads — Tinned with 60/40 tin lead Body — Silicone plastic



C1339

FEATURES & APPLICATIONS

- Fast operate time 10 µs
- High isolation resistance $-\,10^{11}\,\Omega$
- High dielectric strength, input to output -2500 V min. 4N29, 4N32; 1500 V min. 4N30, 4N31, 4N33
- Low coupling capacitance 1.0 pF
- Convenient package plastic dual-in-line
- Long lifetime, solid state reliability
- Low weight 0.4 grams

SYMBOL	INCH MAX.	MM. MAX.	NOTES
Α	.365	9.27	
В	.270	6.73	
С	.130	3.18	
D	15°	15°	
E	.300 Ref	7.62 Ref	1
F	.014	0.36	
G	.325	8.26	
н	.070	1.78	
j	.110	2.79	
ĸ	.022	0.56	
L	.085	2.16	2
M			3
N	.175	4.45	2 3 4 3
P			3

- 1. Installed position of lead centers
- Four places
- Overall installed position
- These measurements are made from the seating plane

ABSOLUTE MAXIMUM RATINGS TA = 25°C (Unless otherwise specified)

*Storage Temperature	55°C + 150°C
*Operating Temperature at Junction	
*Lead Soldering time @ 260°C	
*Lead Soldering time @ 260°C	
Total power dissipation w 25 C applient	050 111
*Derate linearly from 25°C	
1 ED (0-4-D: 1)	DETECTOR (Silicon Photo Darlington Transistor)

*Power dissipation @ 25°C ambient 150 mW *Derate linearly from 55°C 2 mW/°C

*Peak forward current (300 μsec, 2% duty cycle) . . 3.0 A

*Indicated JEDEC Registered data.

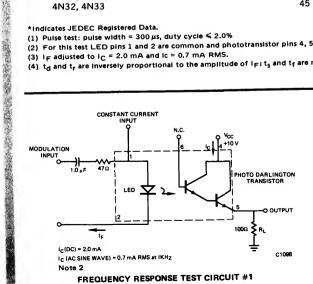
*Power dissipation @ 25°C ambient 150 mW *Derate linearly from 25°C 2.0 mW/°C *Collector-emitter breakdown voltage (BV_{CEO}) 30 V *Collector-base breakdown voltage (BV_{CBO})..... 50 V Emitter-base breakdown voltage (BV_{EBO}).....8.0 V *Emitter-collector breakdown voltage (BV_{ECO}) 5 V

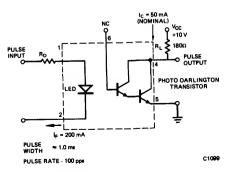
ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITION
LED CHARACTERISTICS TA = 25°C unless otherwise noted) *Reverse leakage current *Forward voltage Capacitance	I _R V _F C		0.05 1.2 150	100 1.5	μΑ Voits pF	V _R = 3.0 V I _F = 50 mA V _R = 0 V, f = 1.0 MHz
PHOTOTRANSISTOR CHARACTERISTIC T _A = 25°C and I _F = 0 unless otherwise not *Collector-emitter dark current	ed) I _{CEO}	20		100	nA - Voits	$V_{CE} = 10 \text{ V}$, base open $I_{C} = 100 \mu\text{A}$, $I_{E} = 0$
*Collector-base breakdown voltage *Collector-emitter breakdown voltage *Emitter-collector breakdown voltage DC current gain	BV _{CBO} BV _{CEO} BV _{ECO} h _{FE}	30 30 5.0	5000		Volts Volts	$I_{C} = 100 \mu\text{A}, I_{B} = 0$ $I_{E} = 100 \mu\text{A}, I_{B} = 0$ $V_{CE} = 5.0 \text{V}, I_{C} = 500 \mu\text{A}$
COUPLED CHARACTERISTICS (T _A = 25°C unless otherwise noted)						
*Collector output current (Note 1) 4N32, 4N33 4N29, 4N30 4N31	lc	50 10 5.0			mA mA mA	$V_{CE} = 10 \text{ V, I}_{F} = 10 \text{ mA, I}_{B} = 0$ $V_{CE} = 10 \text{ V, I}_{F} = 10 \text{ mA, I}_{B} = 0$ $V_{CE} = 10 \text{ V, I}_{F} = 10 \text{ mA, I}_{B} = 0$
*Isolation voltage (Note 2) 4N29, 4N32 4N30, 4N31, 4N33 Isolation capacitance (Note 2)	V _{ISO}	2500 1500			VDC VDC Ohms	V = 500 VDC
*Collector-emitter saturation voltage (1) 4N31 4N29, 4N30, 4N32, 4N33 Isolation capacitance (Note 2) Bandwidth (3) (Test Circuit #1)	V _{CE(SAT})	0.8 30	1.2 1.0	Volts Volts pF kHz	I _C = 2.0 mA, I _F = 8.0 mA I _C = 2.0 mA, I _F = 8.0 mA V = 0, f = 1.0 MHz
SWITCHING CHARACTERISTICS						
(Test Circuit #2) Turn-on time	t _{ON}		0.6	5.0	μs	I _C = 50 mA, I _F = 200 mA, V _{CC} = 10 V
Turn-off time 4N29, 4N30, 4N31 4N32, 4N33	t _{OFF}		17 45	40 100	•	I _C = 50 mA, I _F = 200 mA, V _{CC} = 10 V

*Indicates JEDEC Registered Data. (1) Pulse test: pulse width = 300 μ s, duty cycle $\leq 2.0\%$

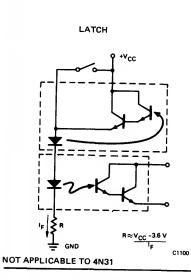
- (2) For this test LED pins 1 and 2 are common and phototransistor pins 4, 5 and 6 are common.
- (3) IF adjusted to IC = 2.0 mA and Ic = 0.7 mA RMS.
- (4), t_d and t_r are inversely proportional to the amplitude of i_F ; t_s and t_f are not significantly affected by i_F .

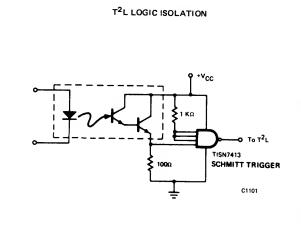


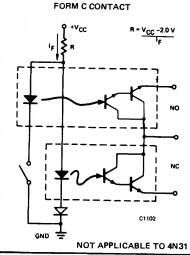


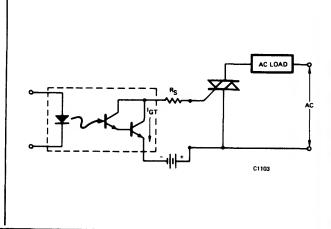
SWITCHING TIME TEST CIRCUIT #2

APPLICATION INFORMATION



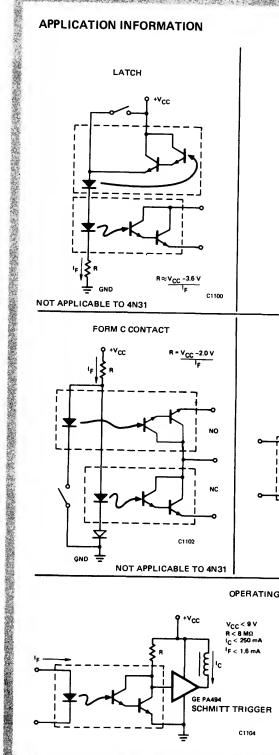


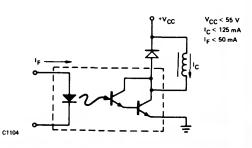




TRIAC TRIGGER

OPERATING A RELAY COIL





TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

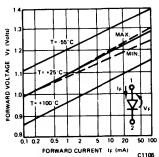


Fig. 1. Forward Voltage Drop vs. Forward Current

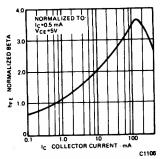


Fig. 2. Normalized Beta vs. Collector Current

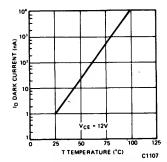


Fig. 3. Dark Current vs. Temperature

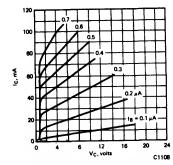


Fig. 4. Detector Standard Transfer Curves

NOTES

- 1. The current transfer ratio ($I_{\rm C}/I_{\rm F}$) is the ratio of the detector collector current to the LED input current with $V_{\rm CE}$ at 10 volts.
- 2. The frequency at which i_C is 3dB down from the IKH_Z value.
- 3. t_{ON} is measured from 10% of the leading edge of the input pulse to the 90% point on the leading edge of the output pulse. t_{OFF} is measured from 90% of the trailing edge of the input pulse to the 10% point on the trailing edge of the output pulse.

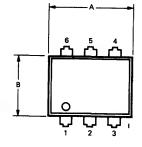
GENERAL INSTRUMENT Optoelectronics

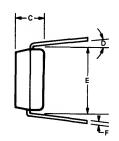
4N36 4N37 PHOTOTRANSISTOR OPTOISOLATORS

PRODUCT DESCRIPTION

The 4N35, 4N36, and 4N37 series of optoisolators have an NPN silicon planar phototransistor optically coupled to a diffused planar gallium arsenide diode. Each is mounted in a six-lead plastic DIP package.

PACKAGE DIMENSIONS



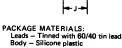


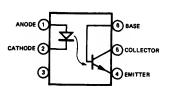
C1339

FEATURES & APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- Industrial controls
- Covered under UL component recognition program, reference File No. E50151
- High DC current transfer ratio
- High isolation voltage

SEATING





SYMBOL	INCH MAX.	MM. MAX.	NOTES
A	.365	9.27	
В	.270	6.73	
C	.130	3.18	
D	15°	15°	
E	.300 Ref	7.62 Ref	1
F	.014	0.36	
G	.325	8.26	
н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
M			2 3 4 3
N I	.175	4.45	4
Р			3

- 1. Installed position of lead centers

- Four places
 Overall installed position
 These measurements are made from the seating plane

ABSOLUTE MAXIMUM RATINGS

*Relative humidity 85% @ 85°C

*Storage temperature -55°C to 150°C

*Operating temperature -55°C to 100°C

Input Diode

*Forward DC current (continuous) 60 mA Reverse voltage 6 volts

*Peak forward current

(1 μs pulse, 300 pps)................. 3.0 A *Power dissipation at T_A = 25°C 100 mWt *Power dissipation at T_C = 25°C 100 mWt

(TC indicates collector lead temp 1/32" from case)

*Indicates JEDEC registered values †Derate 1.33 mW/°C above 25°C. ††Derate 6.7 mW/°C above 25°C.

*Lead temperature (soldering, 10 sec) 260°C

Output Transistor

*Power dissipation at 25°C ambient 300 mW Derate linearly above 25°C 4 mW/°C *Power dissipation at T_C = 25°C 500 mW++

(Tc indicates collector lead temp 1/32" from case)

*V_{CEO} . . .

*Collector current (continuous) 100 mA

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

	SYMBOL	MIN	TVD	MAY	UNITS	TEST CONDITIONS
CHARACTERISTIC	SAMBOL	MIN.	111.	MIAA.	O.C.	
Input Diode		0		1.50	V I	= 10 mA
*Forward voltage	٧ _F	.8 .9		1.7	v i	= 10 mA, T _A = -55°C
*Forward voltage temp. coefficient	V _F	.9 .7		1.4	v i	= 10 mA,
*Forward voltage	V _F	.,		1.4	Ť	A = +100°C
	-			100	pF \	$V_{\rm F} = 0 \text{V}, \text{f} = 1 \text{mHz}$
*Junction capacitance	Cر		.01	100		/ _B = 6.0 V
*Reverse leakage current			.01	10	-	
Output Transistor			250		\	$I_{CE} = 5 \text{ V, } I_{C} = 100 \mu\text{A}$
DC forward current gain	h _{FE}		230			CE C
*Collector to emitter breakdown	D) /	30	65		v I	_C = 10 mA, I _F = 0
voltage	BV_{CEO}	30	05		•	
*Collector to base breakdown	5)./	70	165		V	$_{C} = 100 \mu A$
voltage	вv _{сво}	70	103		· ·	
*Emitter to collector breakdown	D\/	7	14		V	$T_{E} = 100 \mu A, I_{E} = 0$
voltage	BVECO	,	5	50		$V_{CF} = 10 \text{ V, } I_{F} = 0$
Collector to emitter, leakage current	ICEO		,	30		C2
*Collector to emitter leakage				500	μА	V _{CE} = 30 V, I _F = 0,
current (dark)	CEO			300		TA = 100°C
*			8		Pα	V _{CE} = 0
Capacitance collector to emitter			20			V _{CB} = 10 V
Capacitance collector to base	6		10			V _{BE} = 0
Capacitance base to emitter	CBEO		10		μ.	BC.
Coupled	CTR	100			%	$I_F = 10 \text{ mA}, V_{CE} = 10 \text{ V}$
†*DC current transfer ratio	CTR	40			%	I _F = 10 mA, V _{CE} = 10 V
†*DC current transfer ratio	CIR	40				T _A = -55°C
	CTR	•			%	IF = 10 mA, V _{CE} = 10 V,
†*DC current transfer ratio	CIR	40	1		70	$T_{\Delta} = +100^{\circ}C$
						1A 100 1
*Saturation voltage-collector	V -			.3	volts	$I_F = 10 \text{ mA}, I_C = 0.5 \text{ mA}$
to emitter	V _{CE(SA}	Τ)		.3	VOILS	1 10 1111 1, 1C 011
*Input to output isolation current	11-0					
(pulse width = 8 msec)						
(see Note 1)						
Input to output voltage =		4N3		100	μΑ	
3550 V (peak)		411.	33	100	μ/\	
Input to output voltage =					^	
2500 V (peak)		4N	36	100	μА	
Input to output voltage =			~ 7	100	μА	
1500 V (peak)		4N	-	100	μA	Input to output voltage =
*Input to output resistance	R _{I-O}	10	10		gigaoinns	500 V (see Note 1)
	_			2.5	nicofarad	s Input to output voltage =
*Input to output capacitance	C _{1-O}			2.5	picorarau	0 V, f = 1 MHz
						(see Note 1)
			5	10	μsec	$V_{CC} = 10 \text{ V}, I_{C} = 2 \text{ mA},$
*Turn on time—t _{on}	ton		5	10	μισο	$R_1 = 100\Omega$,
						(see Fig. 15)
			5	10	μsec	$V_{CC} = 10 \text{ V}, I_{C} = 2 \text{ mA},$
*Turn off time—t _{off}	toff		5	10	عود س	$R_i = 100\Omega$,
						(see Fig. 15)
						/

^{*}Indicates JEDEC registered values

[†]Pulse test: pulse width = 300μ S, duty cycle $\leq 2.0\%$

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

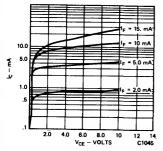


Fig. 1. Collector Current vs. Collector Voltage

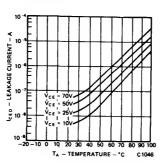


Fig. 2. Dark Current vs. Temperature

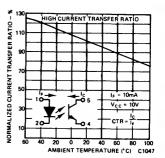


Fig. 3. Current Transfer Ratio vs. Temperature

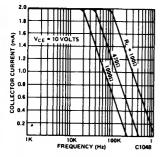


Fig. 4. Collector Current vs. Frequency

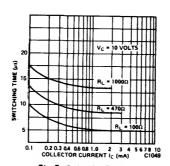


Fig. 5. Switching Time vs. Collector Current

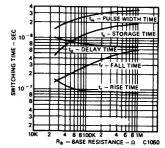


Fig. 6. Switching Time vs. Base Resistance

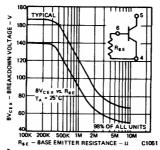


Fig. 7. Collector—Emitter Breakdown Voltage vs. Base Resistance

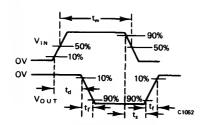


Fig. 8. Test Pulse Definition (Note 3)

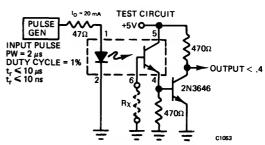


Fig. 9. Pulse Test Circuit for Fig. 7

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

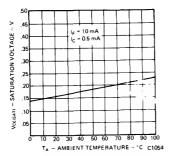


Fig. 10. Saturation Voltage vs. Temperature

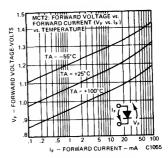


Fig. 11. Forward Voltage vs. Forward Current

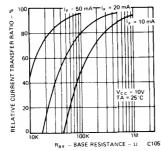


Fig. 12. Sensitivity vs. Base Resistance

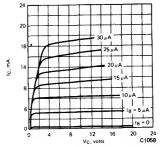


Fig. 13. Detector Standard Transfer Curves

OPERATING SCHEMATICS

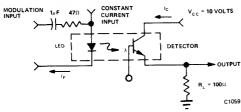


Fig. 14. Modulation Circuit Used to Obtain Output vs. Frequency Plot (Fig. 4)

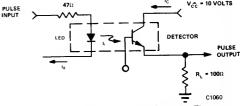


Fig. 15. Circuit Used to Obtain Switching Time vs. Collector Current Plot (Fig. 5)

NOTES

- 1. Tests of input to output isolation current resistance and capacitance are performed with the input terminals (diode) shorted together and the output terminals (transistor) shorted together.
- 2. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.
- Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

GENERAL INSTRUMENT Optoelectronics

(MCC670) 6N138 (MCC671) 6N139 HIGH GAIN SPLIT-DARLINGTON OPTOISOLATORS

FEATURES

- High sensitivity to low input currents
 6N138 300% minimum CTR (I_F = 1.6 mA)
 6N139 400% minimum CTR (I_F = .5 mA)
- Fast switching capability at logic loads

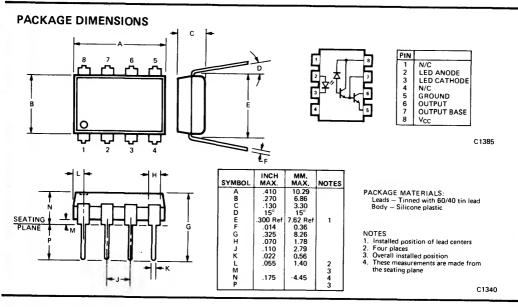
- 6N138 10 Microseconds (t_{on}) 35 Microseconds (t_{off})
- 6N139 1 Microseconds (ton)
 - 7 Microseconds (toff)
- UL Recognized

DESCRIPTION

The 6N138 and 6N139 are optically coupled isolators with a split-darlington output configuration. A red visible emitting diode manufactured from specially grown gallium arsenide is coupled to a photo sensitive circuit.

APPLICATIONS

- CMOS logic interface
- Telephone ring detector
- Low input TTL interface
- Power supply isolation

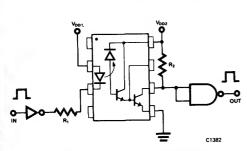


ABSOLUTE MAXIMUM RATINGS*

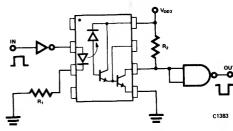
*JEDEC registered data

Storage Temperature55°C to +125°C
Operating Temperature 0°C to +70°C
Lead Solder Temperature 260°C for 10 Sec
(1/16" below seating plane)
Average Input Current – IF
(See Note 1)
Peak Input Current - IF
(50% Duty Cycle, 1 ms Pulse Width)
Peak Transient Input Current - IF 1.0 A
$(< 1 \mu sec pulse width, 300 pps)$
Reverse Input Voltage – V _R 5 V

Input Power Dissipation 35 mW
(See Note 2)
Output Current - IO (Pin 6) 60 mA
(See Note 3)
Emitter-Base Reverse Voltage (Pin 5-7) 5 V
Supply and Output Voltage — V_{CC} (Pin 8-5), V_{CC} (Pin 6-5)
6N1380.5 to 7 ∨
6N139
Output Power Dissipation 100 mW
(See Note 4)



NON-INVERTING LOGIC INTERFACE



INVERTING LOGIC INTERFACE

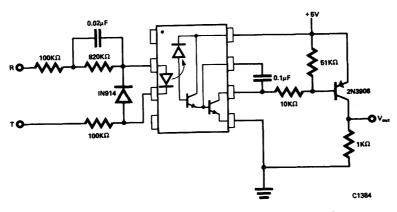
R1 (NON-INVERT) =	VDD1 - VDF - VDL1
Rt (INVERT) =	V _{DD1} - V _{DH1} - V _{DF}
R ₂ =	V _{DD2} - V _{DLX} (● I _L + I ₂)

WHERE: VOD1: INPUT SUPPLY VOLTAGE
VOD2: OUTPUT SUPPLY VOLTAGE
VOD4: DIODE FORWARD VOLTAGE
VOL1: LOGIC "0" VOLTAGE OF ORIVER
VON1: LOGIC "0" VOLTAGE OF ORIVER
IF : DIODE FORWARD CURRENT
VOLX: SATURATION VOLTAGE OF MCC670
IL : LOAD CURRENT THROUGH RESISTOR P2
IS : INPUT CURRENT OF OUTPUT GATE.

CURRENT LIMITING
RESISTOR CALCULATION

			CMOS @ 5V	CMOS @ 10V	74XX	74LXX	74SXX	74LSXX	
		R, (Ω)	$R_2(\Omega)$	R ₂ (Ω)	R ₂ (Ω)	R ₂ (Ω)	$R_2(\Omega)$	$R_2(\Omega)$	R ₂ (Ω)
CMOS	NON-INV.	2000				T	1	1	1
@ 5V	INV.	510]		1	1	l		
CMOS	NON-INV.	5100			1	1	1	i	
@ 10V	INV.	4700		1					i
	NON-INV.	2200]	1	į .	l	1	l	l
74XX	INV.	180]	1		1			
	NON-INV.	1800	1000	1000 2200	750	1000	1000	1000	560
74LXX	INV.	100]						
	NON-INV.	2000]		1	İ	1		!
74SXX	INV.	360	1	Į.	1	Į.	Į.	1	ł
74LSXX	NON-INV	2000			1	1	1	!	
/4L3AA	INV.	180		1		ì	l	1	1
	NON-INV.	2000	_	1			1	1	1
74HXX	INV.	180	1				ــــــــــــــــــــــــــــــــــــــ		

RESISTOR VALUES FOR LOGIC INTERFACE



TELEPHONE RINGING DETECTION USING OPTO-ISOLATOR

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

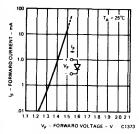


Fig. 1. Input Diode Forward Current vs. Forward Voltage

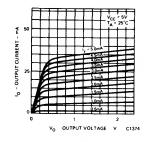


Fig. 2. 6N138 DC Transfer Characteristics

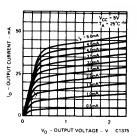


Fig. 3. 6N139 DC Transfer Characteristics

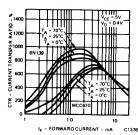


Fig. 4. Current Transfer Ratio vs. Forward Current

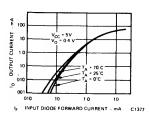


Fig. 5. 6N138 Output Current vs. Input Diode Forward Current

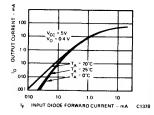


Fig. 6. 6N139 Output Current vs. Input Diode Forward Current

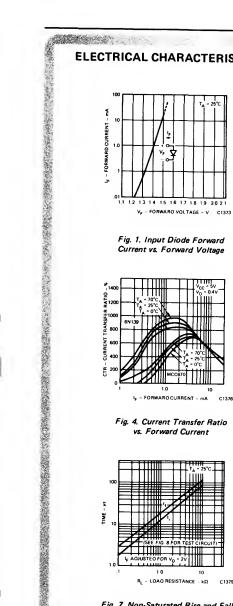


Fig. 7. Non-Saturated Rise and Fall Times vs. Load Resistance

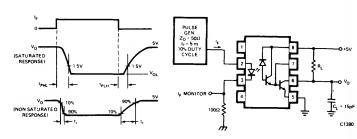


Fig. 8. Switching Test Circuit

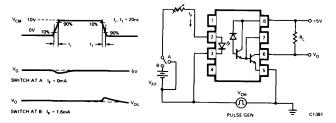


Fig. 9. Test Circuit for Transient Immunity and Typical Waveforms

ELECTRICAL SPEC	IFICATI	ONS (0° to +7	0°C Te	emperati	ıre unle	ss otherwi	se specified)
	SYMBOL	DEVICE	MIN	TYP*	MAX	UNITS	TEST CONDITIONS
*Current Transfer Ratio (Notes 5, 6)		6N139	400 500	800 900		%	$I_F = 0.5 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$ $I_F = 1.6 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$
(140102 0, 0)		6N138	300	600		%	$I_F = 1.6 \text{ mA}, V_O = 0.4 \text{ V}, V_{CC} = 4.5 \text{ V}$
Logic Low Output	VCL	6N139		0.06	0.4	V	I _F = 1.6 mA, I _O = 6.4 mA, V _{CC} = 4.5 V
Voltage (Note 6)				0.08	0.4		$I_F = 5 \text{ mA}, I_O = 15 \text{ mA}, V_{CC} = 4.5 \text{ V}$
				0.09	0.4		$I_F = 12$ mA, $I_O = 24$ mA, $V_{CC} = 4.5$ V $I_F = 1.6$ mA, $I_O = 4.8$ mA, $V_{CC} = 4.5$ V
		6N138		0.06	0.4	V	IF = 1.6 MA, IO = 4.6 MA, VCC = 4.5 V
*Logic High Output	ЮН	6N139		0.1	100	μΑ	$I_F = 0 \text{ mA}, V_O = V_{CC} = 18 \text{ V}$
Currant (Nota 6)		6N138		0.001	250	μΑ	$I_F = 0 \text{ mA}$, $V_O = V_{CC} = 7 \text{ V}$
Logic Low Supply Currant (Nota 6)	ICCL	6N138/6N139		0.20		mA	$I_F = 1.6 \text{ mA}, V_O = \text{Open}, V_{CC} = 5 \text{ V}$
Logic High Supply	Іссн	6N 138/6N 139		10.0		nΑ	I _F = 0 mA, V _O = Open, V _{CC} = 5 V
Current (Note 6) *Input Forward Voltage Reverse Braekdown Voltage	VF	6N138/6N139 6N138/6N139	5	1.45	1.7	v	I _F = 1.6 mA, T _A = 25°C I _R = 10 mA, T _A = 25°C
Temperature Coefficient	ΔVF	6N138/6N139		-1.8		mV/°C	I _F = 1.6 mA
of Forward Voltaga Input Capacitence	ΔT _A C _O	6N138/6N139		40		pF	$f = 1 \text{ MHz}, V_F = 0$
*Isolation Leakaga (Input-Output) (Note 7)	11-0	6N138/6N139			1.0	μА	45% Relative Humidity, $T_A = 25^{\circ}$ C V _{I-O} = 3000 V, $t_d = 5$ sec
Rasistence (Input-Output) (Note 7)	R _{I-O}	6N138/6N139		10 ¹²		Ω	V _{I-O} = 500 Vdc
Capacitanca (Input-Output) (Note 7)	C _{I-O}	6N138/6N139		0.6		pF	f = 1 MHz
(All typicals et T _A = 25°C	end V _{CC} = (5 V, unless otharw	ise not	ed.)			

SWITCHING SPECIF	CATION	IS (T _A = 25°	'C)				
PARAMETER	SYMBOL	DEVICE	MIN	TYP	MAX	UNITS	TEST CONDITIONS
Propagation Deley Time To *Logic Low at Output (See Fig. 8; Notes 6, 8) Propagation Deley Tima To *Logic High at Output (See Fig. 8; Notes 6, 8)	^t PHL	6N139 6N139 6N138 6N139 6N139 6N138		5.0 0.2 1.0 1 0 1.0 4.0	25 1 10 60 7 35	րs իs իs իs	$\begin{split} I_F &= 0.5 \text{ mA, R}_L = 4.7 \text{ k}\Omega \\ I_F &= 12 \text{ mA, R}_L = 270 \Omega \\ I_F &= 1.6 \text{ mA, R}_L = 2.2 \text{ k}\Omega \\ I_F &= 0.5 \text{ mA, R}_L = 4.7 \text{ k}\Omega \\ I_F &= 0.5 \text{ mA, R}_L = 270 \Omega \\ I_F &= 1.6 \text{ mA, R}_L = 2.2 \text{ k}\Omega \end{split}$
Common Mode Transient Immunity et Logic High Lavel Output (Sea Fig. 9; Note 9)	СМН			>500		V/μs	$I_F = 0 \text{ mA}, R_L = 2.2 \text{ k}\Omega$ $ V_{cm} = 10 \text{ V}_{p-p}$
Common Mode Transiant Immunity at Logic Low Level Output (Sae Fig. 9; Note 9)	CML			<-500		V/μs	$I_F = 1.6 \text{ mA}, R_L = 2.2 \text{ k}\Omega$ $ V_{cm} = 10 V_{p-p}$

NOTES

- 1. Derate linearly above 50°C free-air temperature at a rate of 0.4 mA/°C.
- 2. Derate linearly above 50°C free-air temperature at a rate of 0.7 mW/
- 3. Derate linearly above 25°C free-air temperature at a rate of 0.7 mW/ C.
- 4. Derate linearly above 25°C free-air temperature at a rate of 2.0 mW/°C.
- 5. DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, Io, to the forward LED input current, IF, times 100%.
- 6. Pin 7 Open.
- 7. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
- 8. Use of a resistor between pin 5 and 7 will decrease gain and delay time.
- 9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{cm} , to assure that the output will remain in a Logic High state (i.e., $V_0 > 2.0 \text{ V}$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm}, to assure that the output will remain in a Logic Low state (i.e., $V_0 < 0.8 \text{ V}$).

GENERAL INSTRUMENT **Optoelectronics**

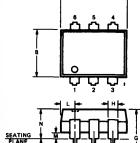
MCA230

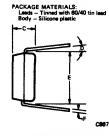
PHOTO-DARLINGTON OPTOISOLATOR

PRODUCT DESCRIPTION

The MCA230 and MCA255 optoisolators contain a gallium arsenide infrared emitting diode optically coupled to a silicon planar photo-darlington transistor. Both units are sealed in a 6-lead plastic DIP package. Electrical isolation compares favorably with that of a relay—without the relay's inherent magnetic field. The MCA230 has a minimum collector-emitter breakdown voltage of 30 volts and the MCA255, 55 volts.

PACKAGE DIMENSIONS





SYMBOL	INCH MAX.	MM. MAX.	NOTES
A	.365	9.27	
B	.270	6.73	
BCD	.130	3.18	
D	15°	15°	
E	.300 Ref		1 1
F	.014	0.36	
Ġ	.325	8.26	
н	.070	1.78	l
J	.110	2.79	
K	.022	0.56	
L	.085	2.18	2
K L			3
N	.175	4.45	4
P			•

- NOTES
- installed position

FEATURES & APPLICATIONS

- High collector current rating-125 mA
- Fast operate time-10 µs
- Fast release time 35 µs
- High isolation resistance— $10^{11} \Omega$
- High dielectric strength, input to output-3550 VDC
- Low coupling capacitance -0.5 pF
- Convenient package—plastic dual-in-line
- Long lifetime, solid state reliability
- Low weight-0.4 grams
- Replace reed relays for 50 mA, 55 V DC loads.
- Replace pulse transformers.
- Form multiple contact, NO/NC relays.
- Useful for telephone lines, telegraph lines, SCR triggers, hospital monitoring systems, airborne systems, remote data gathering systems and remote control systems.
- Use as a low-current alarm monitor for battery powered supplies.

ABSOLUTE MAXIMUM RATINGS

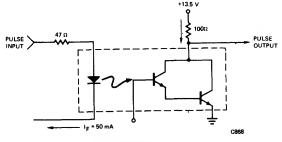
Storage Temperature55°C to 150°C
Operating Temperature55°C to 100°C
Lead Soldering time @ 260°C
Total power dissipation @ 25°C ambient 250 mW
Derate linearly from 25°C 3.3 mW/°C
LED (GaAs Diode)
Power dissipation @ 25°C ambient 90 mW
Derate linearly from 25°C 1.2 mW/°C
Continuous forward current 60 mA
Reverse voltage
Peak forward current (1 μsec pulse, 300 pps) 3.0 A

DETECTOR		
(Silicon Photo Transistor)	MCA230	MCA255
Power dissipation		
@ 25°C ambient	210 mW	210 mW
Derate linearly from 25°C .	. 2.8 mW/°C	.2.8 mW/°C
Collector-emitter breakdowr)	,
woltage (BV _{CEO}) Collector-base breakdown	30 V	55 V
Collector-base breakdown		
voltage (BV _{CBO})	30 V	55 V
Emitter-base breakdown		
voltage (BV _{EBO})	8.0 V	8.0 V
Collector-emitter		
current (I _{CE})	125.0 mA	125.0mA

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
EMITTER						20 2
Forward Voltage	V _F		1.25	1.5	V	I _F = 20 mA
Reverse Voltage	VR	3	25		v_	$I_R = 10 \mu\text{A}$
Capacitance	Cر		50		рF	V = 0
DETECTOR						V 5 V I - 0 5 m 0
Gain	HFE		25,000			$V_{CE} = 5 \text{ V}, I_{C} = 0.5 \text{ mA}$
Collector Breakdown Voltage	BV _{CEO}	30/55			V	$I_{\rm C} = 100 \mu \rm A, I_{\rm F} = 0$
Base Breakdown Voltage	BV _{CBO}	30/55			V	$I_{C} = 10 \mu A, I_{F} = 0$
Emitter Breakdown Voltage	BVEBO	8			V	$I_E = 1 \mu A$, $I_F = 0$
Collector Leakage Current	I _{CEO} (DARK)		1.0	100	nΑ	$V_{CE} = 10 \text{ V, I}_{F} = 0$
Capacitance						
Collector-Emitter			3.4		рF	V _{CE} = 10 V
Collector-Base			10		рF	V _{CB} = 10 V
Emitter-Base			10		pF	V _{EB} = 0.5 V
COUPLED						
DC Base Current Transfer Ratio			0.1		%	$I_F = 50 \text{ mA}, V_{CB} = 10 \text{ V}$
DC Collector Current Transfer Ra	itio	100	400		%	$I_F = 10 \text{ mA}, V_{CE} = 5 \text{ V}, \text{Note } 1$
Saturation Voltage	V _{CE} (SAT)			1.0	V	$I_C = 50 \text{ mA}, I_F = 50 \text{ mA}$
Bandwidth (50% Δ CTR)	OL .		10		kHz	$I_C = 10 \text{ mA}$, Note 2,
Banaman (con a con)						$R_L = 100 \Omega$, $V_{CE} = 10 V$
Fall time	t _f		35		μsec	∫ See switching time test circuit
Rise time	tr		5		μsec	l Note 3
ISOLATION	-1					
DC Voltage Breakdown	V _{ISO}	3550			V	t = 1 second
Resistance	R _{ISO}	10 ¹¹	10 ¹²		Ω	V = 500 VDC
Leakage Current	I _{ISO}		10		μΑ	V _{ISO} = 1500 VDC.
Capacitance	C _{ISO}		0.5		pF	
Dielectric Dissipation Limit	9150	50,000			УHz	RMS
Dielectic Dissipation Limit		2500			VRMS	t = 1 second

SWITCHING TIME TEST CIRCUIT



Pulse Width = 1 ms Pulse Rep Rate = 100 Hz

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

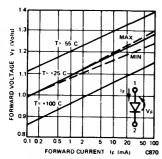
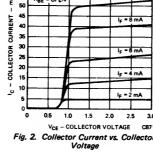


Fig. 1. Forward Voltage Drop vs. Forward Current



TYPICAL 530% CTF

Fig. 2. Collector Current vs. Collector

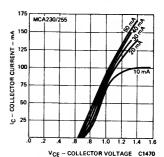


Fig. 3. Collector Current vs. Collector Voltage

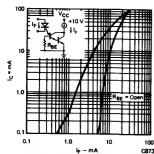


Fig. 4. Current Transfer Characteristic

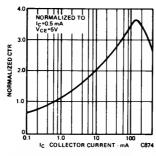


Fig. 5. Normalized CTR vs. Collector Current

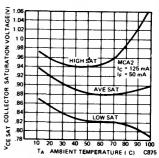


Fig. 6. VCE-SAT vs. Temperature

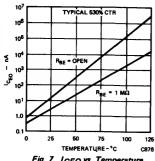


Fig. 7. I_{CEO} vs. Temperature

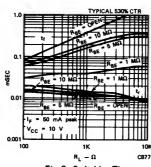


Fig. 8. Switching Times

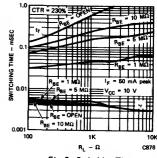


Fig. 9. Switching Times

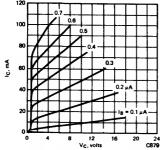


Fig. 10 Detector Standard Transfer Curves

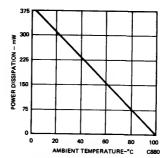


Fig. 11. Package Power Derating

DC RELAY CHARACTERISTICS (TYPICAL)

\mathbf{c}	n	uТ	Δ	\sim	гς

Contact configuration
Contact load rating
Contact withstand voltage

MCA230 MCA255

Closed contact voltage Operate time with 100 $\Omega \, \text{load}$ Release time with 100 $\Omega \, \text{load}$

COIL

Turn on voltage

Turn on current at rated contact load

ISOLATION

Dielectric strength, contacts to coil Isolation resistance, contact to coil Capacitance, contacts to coil

WEIGHT

SPST-NO 50 mA DC

30 V DC 55 V DC

1.0 V 10 μseconds

35 μseconds

1.3 V

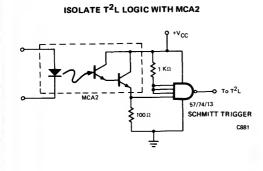
50 mA

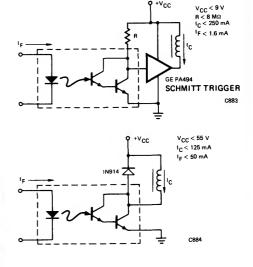
3550 VDC minimum

10¹¹ Ohms 1.0 pF 0.4 grams

APPLICATION CIRCUITS

OPERATING A RELAY COIL WITH MCA2





NOTES

1. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE}

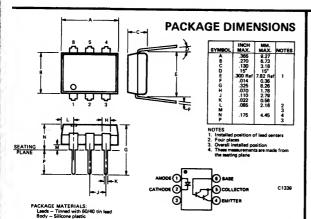
- 2. The frequency at which i_c is 3 dB down from the 1 kHz value.
- Rise time (t_r) is the time required for the collector current to increase from 10% of its final value, to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

GENERAL INSTRUMENT Optoelectronics

MCA231 PHOTO-DARLINGTON OPTOISOLATOR

PRODUCT DESCRIPTION

The MCA231 contains a gallium arsenide infrared emitter optically coupled to a silicon planar photo-darlington. Both units are sealed in a 6-lead plastic DIP package.



FEATURES

- High sensitivity—1 mA on the input will sink a TTL gate.
- High isolation—3550 VDC, $10^{12} \Omega$, 0.5 pF

TYPICAL APPLICATIONS

- Isolate logic from 110/220 VAC.
- Eliminate troublesome ground loop problems by coupling directly to twisted pair lines in digital systems. Particularly useful for telephone lines, telegraph lines, SCR triggers, hospital monitoring systems, airborne systems, remote data gathering systems, and remote control systems.

ABSOLUTE MAXIMUM RATINGS

Storage remperature Range
Operating Temperature Range55°C to +100°C
Lead Temp. (Soldering, 10 sec) 260°C
Total Power Diss. @ 25°C Free
Air Temperature
Derate Linearly to 100° C $(\theta_{JA}) \dots 3.3 \text{ mW/}^{\circ}$ C
Input to Output Isolation Voltage 3550 VDC
(1 second)

Input Diode																			
Forward Current						٠.										6	0 m	١A	
Reverse Voitage																	3.0	v	
Peak Forward Current (1)	μs	p	u	se	, :	30	0	р	ps	()							3.0	Α	
Output Darlington																			
Collector-Emitter Voltage																	30	v	
Collector-Base Voltage .																	30	v	
Emitter-Base Voltage											Ĺ	Ĺ		i		Ī	. 6	v	
Collector Current		ċ													•	12	5 m	١Ā	

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature unless otherwise specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Isolation between emitter and detector						
Capacitance	Ciso		0.5		pF	f = 1 MHz
Resistance	Riso	1011	1012		Ω̈́	V = 500 VDC
Voltage Breakdown	Viso	3550			VDC	t = 1 second
Emitter (GaAs LED)						
Forward Voltage	٧F		1.15	1.5	V	I _F = 20 mA
Reverse Voltage	V _R	3.0	25	2.0	v	IR = 10 μA
Junction Capacitance	ċ, Ĉ	0.0	50		pF	V _R = 0 V
Detector (Silicon Photo-Darlington)	٠,		50		Pr-	VR - UV
Collector Breakdown Voltage	V(BR)CEO	30	60		V	I _C = 1 mA
Base Breakdown Voltage	V(BR)CBO	30	60		v	I _C = 10 μA
Emitter Breakdown Voltage	V(BR)EBO	6	.8		v	I _F = 10 μA
Collector Leakage Current	CEO	•	ĩ	100	nΑ	V _{CE} = 10 V
Saturation Voltage			0.8	1.0	Ÿ	I _C = 2 mA, I _F = 1 mA
Saturation Voltage	VCE(sat)		0.8	1.0	v	
Saturation Voltage	VCE(sat)		0.9	1.2	v	IC = 10 mA, IF = 5 mA
Base photo-current	VCE(sat)		2	1.2		IC = 50 mA, IF = 10 mA
Darlington gain	¦В		50 k		μА	V _{CB} = 5 V, I _F = 10 mA
Collector-emitter capacitance	h _{FE}					I _B = 1 μA, V _{CE} = 1 V
Switching Times, Coupled	CCE		6		pF	V _{CE} = 10 V
Rise time, fall time	t _r , t _f		80			V10V 100 D1000
TTL gate turn-on time			200		μs μs	$V_{CC} = 10 \text{ V, I}_{C} = 10 \text{ mA, R}_{L} = 100 \Omega$
TTL gate turn-off time	^t ON ^t OFF		400		μs μs	IF = 1 mA, Fig. 10
DC Collector Current Transfer Ratio	CTR	200	400		дз %	l⊯ = 1 mA, Flg. 10 lF = 10 mA, V _{CE} = 5 V

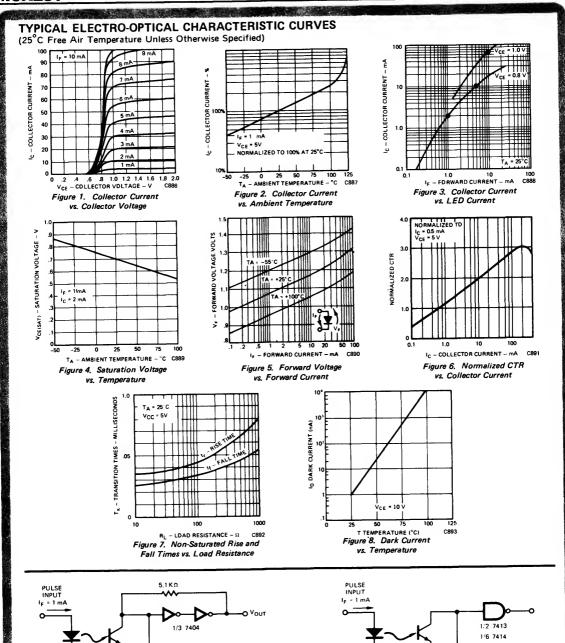


Figure 10. Logic Interface

C896



GENERAL INSTRUMENT Optoelectronics

MCL601 MCL611

OPTICALLY ISOLATED LOGIC GATE

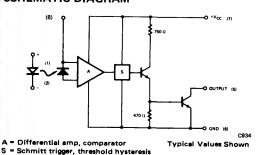
PRODUCT DESCRIPTION

The MCL601 and MCL611, are optically isolated logic gates in an 8-lead DIP package. A GaAs LED radiates infrared light onto a high speed photodiode detector, thus providing electrical isolation of ±2000 V between input and output. A differential comparator amplifies the photodiode signal, and a Schmitt trigger improves noise immunity by providing threshold and hysteresis. A standard open collector circuit on the output offers normal current sinking capability. The LED drive current requirement matches either mode of logic loading. The output is compatible to most logic systems. The MCL601 has a 0.1 MHz data rate; the MCL 611 has a 1 MHz data rate.

PACKAGE DIMENSIONS ALL OMENSIONS IN INCHES A

C933

SCHEMATIC DIAGRAM



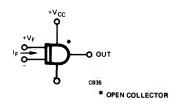
FEATURES

- Compatible TTL input drive load
- Output compatible to TTL, DTL, RTL, CTL, HiNIL
- Single +5 V_{CC} supply required
- High toggle speed, high data rate
- Short transmission delay
- Small 8 pin DIP, two packages fit 16 pin socket
- High isolation between input-output
- High CMRR (Common Mode Rejection Ratio)
- Built-in hysteresis for noise immunity
- Output ORing capability

APPLICATIONS

- Digital logic to digital logic isolator—eliminates spurious grounds
- DC input level sensor—Schmitt trigger toggle
- AC to TTL conversion—square wave shaping
- Line receiver—eliminates CMN and ground loop transients
- Logic level shifter, input-output independent ground systems

SYMBOL



ABSOLUTE MAXIMUM RATINGS

Operating temperature	-55°C to +150°C
Input Diode	Output Gate Power dissipation at 25°C ambient 100 mW Derate linearly from 25°C 1.33 mW/°C DC supply current I _{CC} 30 mA Output collector voltage V _{SS} 15V

Note: The input is not specified as "HI" or "LOW" as with normal gate units. The input is "ON" or "OFF," set by the current flow through the input LED. Thus the input may be "ON" for logic drive "HI" (pull up load system, Figure 1A) or logic drive "LOW" (pull down load systems, Figure 1B, as in open collector output devices.) See Z plot.

As a convenience of notation, reference will be made to a pull down type load input connected as in Figure 1B. A logical "LOW" is "ON", and a logical "HI" is "OFF".

Vcc,

Figure 18

HYSTERESIS, AIE

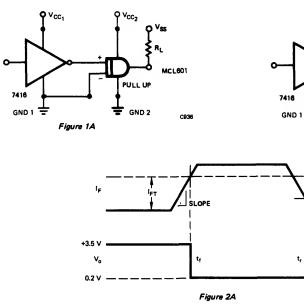
C938

MCL601

C937

PULL DOWN

GND 2



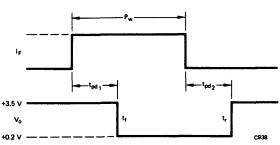
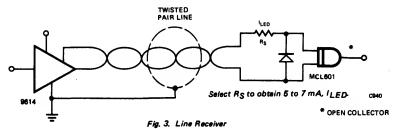


Figure 2B

The MCL input may be driven in series or in parallel with other MCL units, and/or in parallel with other logic units. The input of the MCL has an equivalent unit load (U.L.) rating related to current requirements.



RECOMMENDED OPERATING CONDITIONS

			LIMITS		
PARAMETER		MIN.	TYP.	MAX.	UNITS
Supply Voltage V _{CC}		4.5	5.0	5.5	Volts
Operating Free Air Temperature Range		0	25	70	°C
Normalized Fan Out Logic HIGH				20	U.L.
Logic LOW				10	U.L.
Maximum Input Rise and Fall Time MInimum Input Rise and Fall Time MInimum Pulse Width	Slope		{ No Res See Fig least _{tp}		

ELECTRICAL CHARACTERISTICS (25°C)

PARAMETER	SYMBOL	MIN.	LIMITS TYP. (Note 2)	MAX.	UNITS	TEST CONDITIONS (Note 1)
Input Diode						
Forward Voltage	V _F		1.25	1.50	v	I _E = 20 mA
Forward Voltage Temp Coefficient	*F		-1.8	1.50	m∨/°C	IF - 20 IIIA
Reverse Breakdown Voltage	BV _R	3.0	5.5		v	ι _P = 10 μΑ
Reverse Leakage Current	- · R	0.0	.001	10	μA	V _R = 3.0 V
Junction Capacitance	C1		50		pF	V _F = 0
Rise Time	tr		20		ns	$I_F = 50 \text{ mA}, 50\Omega \text{ system}$
Fall Time	tf		20		ns	$I_F = 50 \text{ mA}, 50\Omega \text{ system}$
Output						p
Output Current HIGH (collector leak	age) I _{OHL}			200	μΑ	V _{CC} = 4.5 V, I _F = 0 mA V _{OH} = 15 V
Output ∨oltage LOW	V _{OL}		0.2	0.4	Volts	V _{CC} = 4.5 V, I _F = (ON)MAX I _{OL} = 16 mA
Supply Current HIGH	I _{CCH}		6	15	mA	V _{CC} = 5.5V, I _E = 0 mA
Supply Current LOW	ICCL		10	25	mA	V _{CC} = 5.5V, I _F = 20 mA
MCL601, 5 mA DRIVE (V _{CC} = 5 V)	CCL					СС 333, Д
Switching Characteristics (Fig. 2B)						
t _{pd} (On)			2	4	μs	I _E =-3.0 mA
t _{od} (Off)			2	4	μs μs	I _E = 3.0 mA
tr, tf			10	•	ns	$C_{L} = 25 \text{ pF}, R_{L} = 280\Omega$
Binary data rate		0.1	0.2		MHz	$I_{\rm F} = 3.0 \text{mA}, R_{\rm I} = 280 \Omega$
Input Diode					12	.F 0.0 ,[200 10
I _F (On)			3.0	5.0	mA	
I _F (Off)		0.5	2.0		mA	
ΔI _F (hysteresis)			1.0		mA	
V _F (On)			1.15		V	I _E = 5.0 mA
V _F (Off)			0.95		V	I _F = 1.0 mA
Input load equivalent			2		U.L.	
MCL611, 15 mA DRIVE (V _{CC} = 5 V)						
Switching Characteristics (Fig. 2B) tod (On) (Fig. 9)			.3	.6	***	1 = 10 == 0
t _{pd} (Off)			.3	.0	μs μs	I _F = 10 mA I _E = 10 mA
tr. tf			10		μs ns	$C_L = 25 \text{ pF}, R_L = 280\Omega$
Binary data rate		1.0	1.2		MHz	I _E = 3.0 mA, R ₁ = 280 Ω
Input Diode (Fig. 11)					141112	1F - 0.0 IIIA, NE - 200 15
l _E (On)			10	15	mA	
I _F (Off)		2.0	5	•	mA	
ΔI _F (hysteresis)			5		mA	
V _F (On)			1.1	1.30	V	I _E = 10 mA
V _F (Off)		1.00	1.1		V	I _F = 2.5 mA
Input load equivalent			6		U.L.	•
ISOLATION						
DC Voltage Breakdown		2000			VDC	t = 1 second
AC Voltage Limit @ 60 Hz		800			VRMS	
Capacitance Resistance			1.0 10 ¹²		pF Ω	v = 500 VDC

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TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

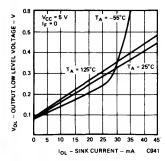


Fig. 4. Low Level Output Voltage vs. Sink Current

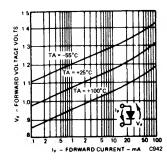


Fig. 5. Forward Voltage vs. Forward Current

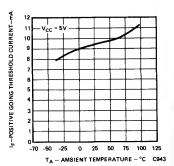
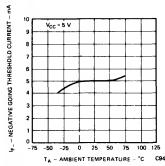
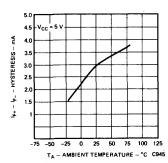
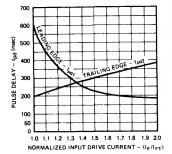
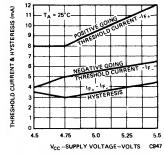


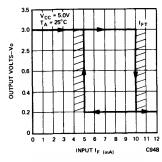
Fig. 6. MCL 611-Positive Going Threshold Current vs. Ambient Tempereture

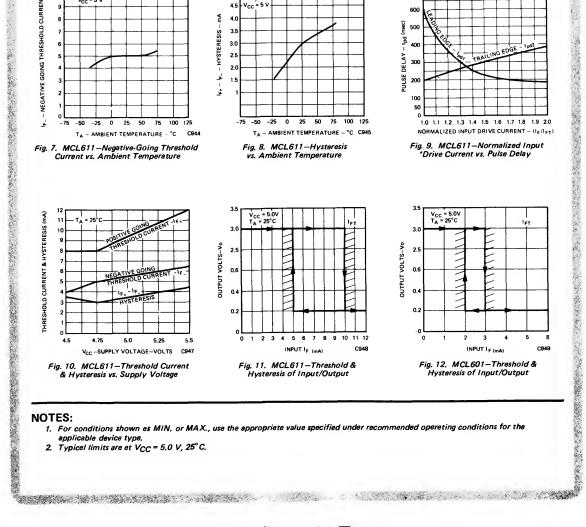












GENERAL INSTRUMENT Optoelectronics

MCS2 MCS2400 PHOTO SCR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCS2 and the MCS2400 devices consist of a photo SCR coupled to a gallium arsenide infrared diode in a six lead plastic DIP package. The MCS2 has a blocking voltage rating of 200 volts while the MCS2400 has a 400 volt rating.

PACKAGE DIMENSIONS | Print |

FEATURES & APPLICATIONS

- Built-in memory
- AC switch (SPST)
- High current carrying capability (pulsed condition)
- Plastic dual-in-line package
- High isolation resistance— $10^{11} \, \Omega$
- Compact, rugged, light-weight
- Low coupling capacitance . . . 1.0 pF typical
- MCS2400, UL recognized (File #E50151)

The Photo SCR coupled pair is intended for applications where complete electrical isolation is required between low power circuitry, such as integrated circuits, and AC line voltages. It provides high speed switching of relay functions. Because of its bistable characteristics, it lends itself for use as a latching re-lay in direct current circuits.

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Unless Otherwise Specified)

		MCS2	_		MCS2400	٥		
CHARACTERISTICS	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE								
Forward voltage (V _F)		1.25	1.5		1.25	1.5	V	I _F = 20mA
Reverse voltage (V _R)	3.0	_	_	3.0	_	_	v	I _R = 10 μA
Reverse current (IR)	_	.001	10	_	.001	10	μΑ	V _R = 3.0 V
Junction capacitance (C _J)	_	50	_	_	50	-	pF	V = 0
DETECTOR								1
Forward leakage current (I _{FX})	_	.02	2.0	_	.02	2.0	μΑ	V_{FX} = Rated V_{FX} , R_{GK} = 27k Ω
Reverse leakage current (IRX)	_	.02	2.0	_	.02	2.0	μΑ	V _{RX} = Rated V _{RX} , R _{GK} = 27kΩ
Forward blocking voltage (V _{FXM} , V _{DM})	200	_	_	400	_	_	v	$R_{GK} = 10k\Omega @ 100^{\circ}C$
Reverse blocking voltage (V _{ROM})	200	_	_	400	_	_	V	R _{GK} = 10kΩ @ 100°C
On voltage (V _{TM})	_	.98	1.3	_	.98	1.3	V	I _T = 100 mA
Holding current (I _{HX})	.01	.16	.50	.01	.16	.50	mΑ	$R_{GK} = 27k\Omega$
Gate trigger voltage (V _{GT})	_	0.5	1.0	_	0.6	1.0	V	V _{FX} = 100 V
Gate trigger current (I _{GT})	_	19	100	-	23	100	μΑ	$V_{FX} = 100 \text{ V, R}_L = 10 \text{k}\Omega, R_{GK} = 27 \text{k}\Omega$
COUPLED								
Turn on current (threshold), (I _{FT})	0.5	5.0	14	0.5	5.0	14	mA	$V_{FX} = 100 \text{ V}, R_{GK} = 27 \text{k}\Omega$
t _r + t _d (See note 1) = (t _{on})	_	7	_	_	7	_	μs	$I_F = 30 \text{ mA}, R_{GK} = 27 \text{k}\Omega, V_{CC} = 20 \text{ V}$
Steady state voltage (V _{ISO})	3150	_	_	3150	_	_	VDC	t = 1 min.
	2250	-	-	2250	_	_	VRMS	t = 1 min.
Surge isolation rating	3550	_	_	3550	_	_	VDC	t = 1 sec.
	2550	_	_	2550	-	-	VRMS	t = 1 sec.
Isolation resistance (R _{ISO})	10 ¹¹	10 ¹²	_	1011	10 ¹²	_	Ω	V = 500 VDC
Isolation capacitance (C _{ISO})	_	1.0	2	_	1.0	2	pF	f = 1 MHz

ABSOLUTE MAXIMUM RATINGS

Storage temperature -55°C to 150°C Operating temperature -55°C to 100°C Lead soldering time @ 260°C 7.0 seconds

LED (GaAs Diode)
Power dissipation @ 25°C ambient 90 mW
Derate linearly from 25°C
Continuous forward current 60 mA
Reverse voltage 3.0 V
Peak forward current 0.5 A
(50 μs pulse, 120 pps)
COUPLED
Isolation voltage
Total package power dissipation 250 mW
Derate linearly from 25°C 3.3 mW/°C

STATE OF THE STATE

ELECTRO-OPTICAL CHARACTERISTIC CURVES (25°C Free Air Unless Otherwise Specified)

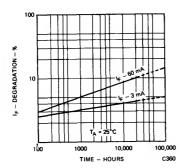


Fig. 1. LED Lifetime vs. Forward Current

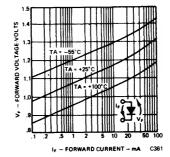


Fig. 2. Forward Voltage vs. Forward Current

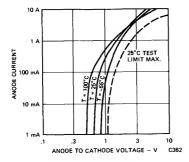


Fig. 3. Anode Current vs. Anode-Cathode Voltage

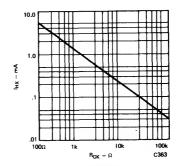


Fig. 4. Holding Current vs. Gate-Cathode Resistance

ELECTRO-OPTICAL CHARACTERISTIC CURVES (Cont'd) (25°C Free Air Unless Otherwise Specified)

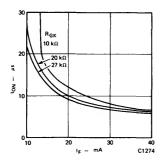


Fig. 5. Trigger Delay Time vs. Forward Current (note 1)

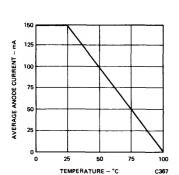


Fig. 7. Continuous Current Rating vs. Ambient Temperature

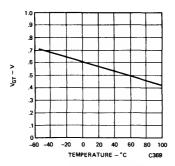


Fig. 9. Gate Trigger Voltage vs. Temperature

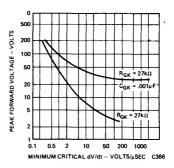


Fig. 6. Forward Blocking Voltage vs. Critical dV/dt

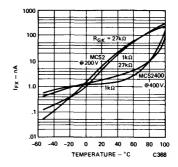


Fig. 8. Forward Leakage Current vs. Temperature

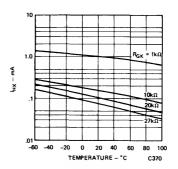
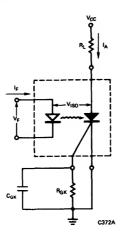
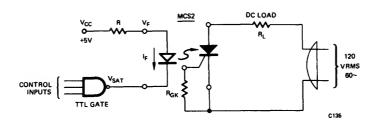


Fig. 10. Holding Current vs. Temperature

TYPICAL CIRCUIT APPLICATIONS



OPERATING SCHEMATICS



RELAY CIRCUIT FOR HALF WAVE A.C. CONDUCTION

NOTES

1. The rise time of the SCR is typically less than 500 nanoseconds.

GENERAL INSTRUMENT Optoelectronics

MCS6200 MCS6201

OPTICALLY ISOLATED SOLID STATE AC DIP RELAY

PRODUCT DESCRIPTION

LED (GaAs Diode)

Power dissipation @ 25°C ambigue

The MCS6200 series are optically-isolated solid state relays with two photo-SCR's connected Anode-to-Cathode (see circuit diagram). Two Light Emitting Diodes, coupled to the photo-SCR's, provide independent SCR control. The MCS6200 features an input to output minimum breakdown voltage of 1500 VDC, while the MCS6201 features 2500 VDC.

FEATURES

- Fast switching
- Independent direction control
- · Low input control power
- · High pulse current capability
- High voltage isolation between input and output
- Compact plastic DIP package

APPLICATIONS

- AC power control
- Triac triggering
- Bi-directional motor control
- DC power supply polarity control

ABSOLUTE MAXIMUM RATINGS Storage temperature -55° to 150°C Operating temperature -55°C to 100°C Lead soldering time @ 260°C 7.0 seconds

rower dissipation @ 25 Campient 90 mw
Derate linearly from 25°C 1.2 mW/°C
Continuous forward current 60 mA
Reverse voltage 3.0 volts
Peak forward current 0.5 A
(50 μ s pulse, non-repetitive)
COUPLED
Total package power dissipation
at 25°
Derate linearly from 25°C 3.1 mW/°C
Input to output breakdown voltage
MCS6200
MCS6201

Compared the rest of the second section of the
DETECTOR (Photo SCR) each direction	
Power dissipation @ 25°C ambient 2	00 mW
Derate linearly from 25°C2.67 i	mW/°C
Continuous forward current	50 mA
Peak pulse current (100 μsec @ 120 pps)	0.5 A
Average gate current	25 mA
Reverse gate current	1.0 mA

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

STIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
je	VF		1.25	1.5	V	I _E = 20 mA
е	V _R	3.0	_	_	V	$I_{R}^{\Gamma} = 10 \mu A$
t	I _R	_	.001	10	μΑ	V _R = 3.0 V
itance	CJ	_	50	_	pF	V _F = 0 V
	STIC ge e et citance	ge V _F e V _R ott	ge V _F e V _R 3.0 tt I _R —	ge V _F 1.25 e V _R 3.0 — tt I _R — .001	ge V _F 1.25 1.5 e V _R 3.0 — — tt I _R — .001 10	ge V _F 1.25 1.5 V e V _R 3.0 — V tt I _R — .001 10 µA

and the same of the same			47,47.376	4 2 2 10 10		
ELECTRO-OPTICAL	L CHARACT	ERISTI	CS (Cor	n't)		
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DETECTOR (each)	•					
Forward leakage						
current (Note 2)	IFX		.02	2.0	μΑ	V_{FX} = Rated V_{FXM} , R_{GK} = 27 Ω
Max. forward					•	12 120
blocking voltage	VFXM	200			V	$R_{GK} = 27 k\Omega$
On voltage	V _{TM}	_	1.0	1.3	v	I _T = 100 mA
Holding current	IHX	.01	.15	2.0	m/A	$R_{GK} = 27 k\Omega$
Gate trigger voltage	V _{GT}		.5	1.0	v	V _{FX} = 100 V
Gate trigger current	I _{GT}		15	100	μA	$V_{EX} = 100 \text{ V}, R_{I} = 10 \text{ k}\Omega, R_{GK} = 27 \text{ k}\Omega$
(direct drive)	I _{GT}	_	45	500	μΑ	V_{EX} = 100 V, R_L = 10 k Ω , R_{GK} = 10 k Ω
(direct drive)	I _{GT}		0.5	2.0	mA	$V_{EX} = 100 \text{ V}, R_{I} = 10 \text{ k}\Omega, R_{GK} = 1 \text{ k}\Omega$
	.					
COUPLED						
Turn on current	I _{ET}	2	8	14	mΑ	V_{FX} = 100 V, R_{GK} = 27 k Ω
Trigger time	$t_{on} = t_r + t_d$		10.0		μsec	$R_{GK} = 27 k\Omega, I_F = 30 mA, V_{CC} = 20 V$
AC turn on current	l _E	20	_		mΑ	$V_{CC} = 120 \text{ VAC, I}_{T} = 100 \text{ mA,}$
(Note 1)						$R_{GK} = 27 k\Omega$
ISOLATION						
Isolation breakdown						
voltage	V _{ISO}					t = 1 second
MCS6200		1500		_	VDC	
MCS6201		2500		_	VDC	
			11		_	V = 500 VDC

Note 1. To ensure conduction in both directions, see "TRIAC CONNECTION" schematic.

1011

1.0

Note 2. R_{GK} applied to both channels simultaneously.

Isolation resistance

Capacitance

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

R_{ISO}

Ciso

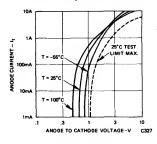


Fig. 1. IT vs. VTM

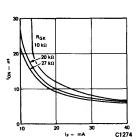
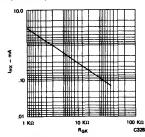


Fig. 4. Trigger Delay Time vs. Forward Current



Ω

pf

V = 500 VDC

f = 1 MHz

Fig. 2. Holding Current (IHX vs. RGK)

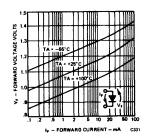


Fig. 5, Forward Voltage vs. Forward Current

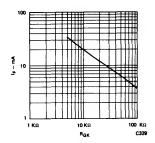


Fig. 3. Turn On vs. RGK

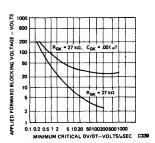


Fig. 6. dV/dt @ 25°C

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (Con't)

(25° Free Air Temperature Unless Otherwise Specified)

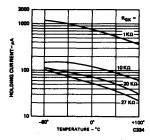


Fig. 7. IHX vs. Temp. °C

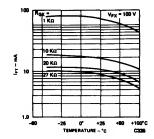


Fig. 8. IFT vs. Temp.

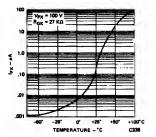


Fig. 9. IFX vs. Temp.

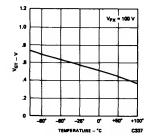


Fig. 10. Gate Trigger Voltage V_{GT} vs. T

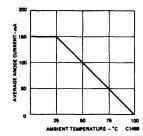
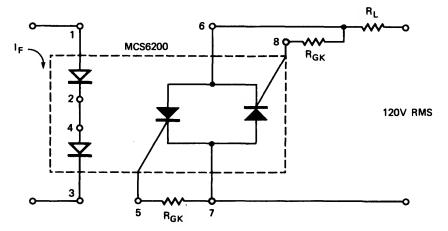


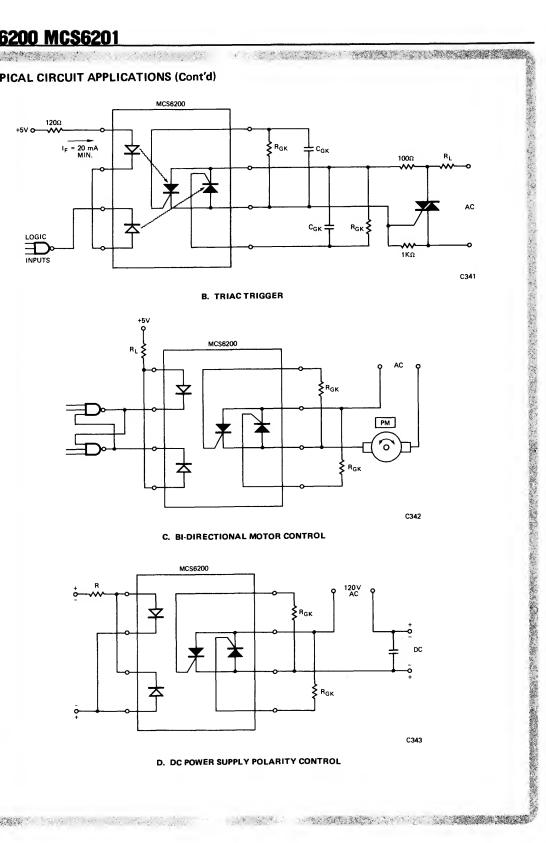
Fig. 11. Anode Current Derating

TYPICAL CIRCUIT APPLICATIONS

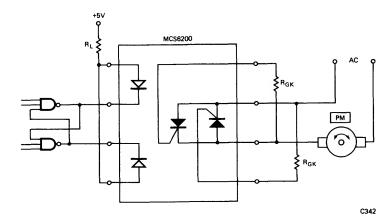


C340

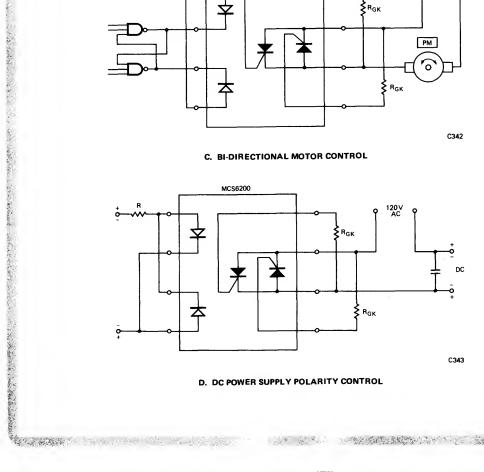
TYPICAL CIRCUIT APPLICATIONS (Cont'd)



B. TRIAC TRIGGER



C. BI-DIRECTIONAL MOTOR CONTROL



D. DC POWER SUPPLY POLARITY CONTROL

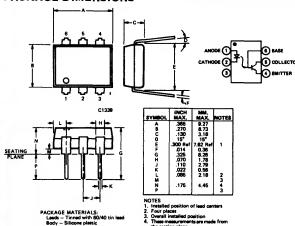
GENERAL INSTRUMENT Optoelectronics

MCT2 PHOTOTRANSISTOR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCT2 is a NPN silicon planar phototransistor optically coupled to a gallium arsenide diode. It is mounted in a six-lead plastic DIP package.

PACKAGE DIMENSIONS



APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor

ABSOLUTE MAXIMUM RATINGS

Storage temperature -55°C to 150°C Operating temperature -55°C to 100°C Lead temperature (Soldering, 10 sec) 260°C

Output Transistor
Power dissipation at 25°C ambient200 mW
Derate linearly from 25°C2.6 mW/°C
Input to output voltage isolation 1500 volts DC
Total package power dissipation at

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

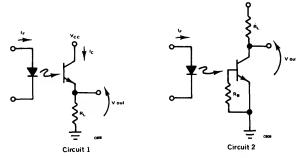
CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Input Diode						
Forward Voltage	V _F		1.25	1.50	٧	I _F = 20 mA
Reverse Breakdown Voltage Junction Capacitance	BV₽	3.0	25 50		V	I _R =10 μA V _F =0 V
· ·	C٦				pF	•
Reverse Leakage Current	I _R		.01	10	μΑ	V _R =3.0 ∨
Output Transistor						
DC Forward Current Gain	hFE		250			V_{CE} =5 V, I_{C} =100 μ A
Collector To Emitter Break-						
down Volt.	BVCEO	30	85		V	I _C =1.0 mA, I _F =0
Collector To 'Base Break-						
down Voltage	BV _{CBO}	70	165		٧	I _C =10 μA
Emitter to Collector Break-						1 - 100 - 0 1 - 0
down Voltage	BV _{EC O}	7	14		V	$I_E = 100 \mu A, I_F = 0$
Collector To Emitter, Leak-			_			
age Current	CEO		5	50	nΑ	V _{CE} =10 V, I _F =0
Collector To Base Leak- age Current	Сво		0.1	20	nΑ	V _{CB} =10 V, I _F =0

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Capacitance Collector To Emitter	C _{CEO}		8		pF	V _{CE} =0
Capacitance Collector To Base	C _{CBO}		20		pF	V _{CB} =10 V
Capacitance Emitter To Base	CEBO		10		pF	V _{BE} =0
Coupled DC Collector Current Transfer Ratio	I _{C/IF}	20	60		%	V_{CE} =10 V, I_F =10 mA, Note 1
DC Base Current Transfer Ratio Isolation Voltage	I _{B/IF}	1500 800	.35 2300		% VDC VRMS	V _{CB} =10 V, I _F -10 mA f=60 Hz
Isolation Resistance		1011	1012		Ω	V _{1.0} =500 V
Isolation Resistance Isolation Capacitance Collector-Emitter, Saturation		10	.5		pF	f=1MH _₹
Voltage	V _{CE} (sat)		0.24	0.4	V	$I_C = 2.0 \text{ mA, } I_F = 16 \text{ mA}$
Bandwidth (see note 2)	B _W		150		KH z	$_{\rm C}$ =2 mA, $_{\rm CE}$ =10 V, $_{\rm RL}$ =100 Ω (Circuit No. 1)
SWITCHING TIMES			TYP.		UNITS	TEST CONDITIONS
Saturated t on (from 5 V to 0.8 V) t off (from SAT to 2.0 V)	t _{on} (SAT) t _{off} (SAT)		10 30		μs	$R_L = 2 K\Omega$, $I_F = 15 mA$, $V_{CC} = 5 V$ $R_B = open (Circuit No. 2)$
Saturated t on (from 5 V to 0.8 V) t off (from SAT to 2.0 V)	t _{on} (SAT) t _{off} (SAT)		10 27		μs	R_L =2 K Ω , I_F =20 mA, V_{CC} =5 V R_B =100 K Ω (Circuit No. 2)
Non-Saturated Base Rise Time Fall Time	t _r t _f		300 300		ns ns	$R_L=1$ K Ω , $V_{CB}=10$ V

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)



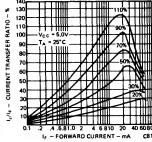


Fig. 1. Current Transfer Ratio vs. Forward Current

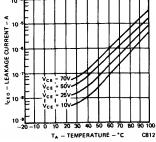


Fig. 2. Dark Current vs. Temperature

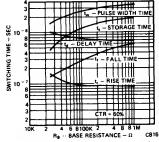


Fig. 3. Switching Time vs. Base Resistance

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (25° C Free Air Temperature Unless Otherwise Specified)

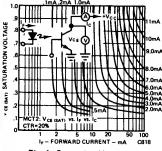


Fig. 4. Seturation Voltage vs. Forward Current

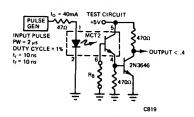


Fig. 5. Circuit for Figure 3

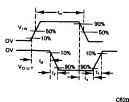


Fig. 6. Weveforms for Figure 3

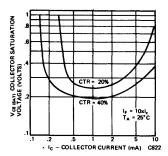


Fig. 7. Saturation Voltage vs. Collector Current

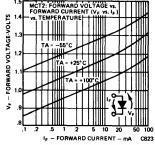


Fig. 8. Forward Voltege vs. Forward Current

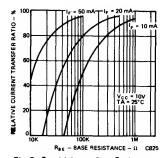


Fig. 9. Sensitivity vs. Bese Resistance

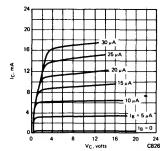


Fig. 10. Detector Typical hfe Curves

NOTES

- 1. The current trensfer retio (IC/IF) is the retio of the detector collector current to the LED input current with VCE at 10 volts.
- 2. The frequency et which $i_{\rm c}$ is 3 dB down from the 1 kHz value.
- Rise time (t_f) is the time required for the collector current to increase from 10% of its final value, to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value, to 10%.

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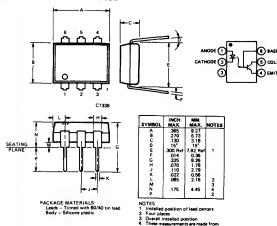
GENERAL INSTRUMENT Optoelectronics

MCT2E PHOTOTRANSISTOR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCT2E is a NPN silicon planar phototransistor optically coupled to a gallium arsenide diode. It is mounted in a six-lead plastic DIP package.

PACKAGE DIMENSIONS



APPLICATIONS

- Utility/economy isolator
- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor
- UL Approved Product File E50151

ABSOLUTE MAXIMUM RATINGS

Storage temperature -55°C to 150°C Operating temperature -55°C to 100°C Lead temperature (Soldering, 10 sec) 260°C

Input Diode
Forward current 60 mA
Reverse voltage 3.0 V
Peak forward current
(1 µs pulse, 300 pps)
Power dissipation at 25°C ambient 200 mW
Derate linearly from 25°C 2.6 mW/°C
Output Transistor
Power dissipation at 25°C ambient 200 mW

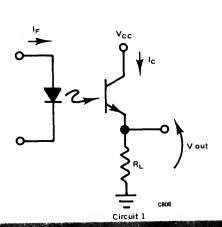
Derate linearly from 25°C 2.6 mW/°C Isolation rating 3550 VDC
Total package power dissipation at 25°C ambient (LED plus detector) 250 mW
Derate linearly from 25°C 3.3 mW/°C Collector-Emitter Current (I_{CE}) 50 mA

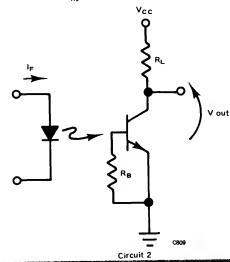
ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP	MAX.	UNITS	TEST CONDITIONS
Input Diode						
Forward Voltage	VF		1.25	1.50	V	l _E = 20 mA
Reverse Breakdown Voltage Junction Capacitance	BV _R C _J	3.0	25 50		V pF	I _R =10 μA V _F =0 V
Reverse Leakage Current	I _R		.01	10	μΑ	V _R ≈3.0 V
Output Transistor						
DC Forward Current Gain	h _{FE}	100	250			$V_{CE} = 5 \text{ V}, I_{C} = 100 \mu \text{A}$
Collector To Emitter Break-	· -					CE 11.6 221,
down Volt.	BVCEO	30	85		V	I _C =1.0 mA, I _F =0
Collector To 'Base Break-						
down Voltage	BV _{C BO}	70	165		V	$I_C = 10 \mu A$
Emitter to Collector Break-						
down Voltage	BV _{EC O}	7	14		V	$I_E = 100 \mu A, I_F = 0$
Collector To Emitter, Leak-						
age Current	CEO		5	50	nΑ	$V_{CF} = 10 V, I_{F} = 0$
Collector To Base Leak-						52
age Current	Сво		0.1	20	nΑ	V _{CB} =10 V, I _F =0

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

CHARACTER	ISTIC	SYMBOL	GUAR. MIN.	TYP.	GUAR. MAX.	UNITS	TEST CONDITIONS
Capacitance Co Emitter	ollector To	CCEO		8		ρF	V _{C E} =0
Capacitance Co Base	ollector To	ССВО		20		pF	V _{CB} =10 V
Capacitance Er	mitter To Base	CEBO		10		pF	V _{BE} =0
	Current Transfer	I _{C/IF}	20	60		%	V _{CE} =10 V, I _F =10 mA, Note 1
Ratio	t Tf Datie	IB/IF		.35		%	V _{CB} =10 V, I _F -10 mA
Surge isolation	nt Transfer Ratio	V _{iso}	3550			VDC	Relative humidity $\leq 50\%$ T _A = +25°C, I _{1-O} $\leq 10 \mu$ A
			2500			VAC-rms	1 second
Steady state is	olation	v _{iso}	3150			VDC	Relative humidity $\leq 50\%$, T _A = +25°C, i _{j-O} \leq 10 μ A
			2250			VAC-rms	1 minute
Isolation Volta	200		2500			VRMS	f = 60 Hz
ISOIation Voite	uye	B _V (1-O)	3500			VDC	
Isolation Resis	******	50(1.0)	1011	1012		Ω	V _{I-O} =500 V
Isolation Capa				.5		ρF	f=1MH ₂
	tter, Saturation						
Voltage	ctor, buttered	V _{CE} (sat)		0.24	0.4	V	I _C = 2.0 mA, I _F = 16 mA
Bandwidth (see	note 2)	B _W		150		KH≉	$I_{\rm C}$ =2 mA, $V_{\rm CE}$ =10 V, R _L =100 Ω (Circuit No. 1)
SWITCHING	TIMES			TYP.		UNITS	TEST CONDITIONS
Non-Saturated							
Collector	Delay Time	t _d		0.5		μs	$R_L = 100 \Omega$, $I_C = 2 mA$, $V_{CC} = 10 V$
Concetor	Rise Time	t,		2.5			(Circuit No. 1)
	Storage Time	t		0.1			
	Fall Time	t,		2.6			
Non-Saturated	1	•					O O A . V 10V
Collector	Delay Time	t _a		2.0		μs	$R_L=1 K\Omega$, $I_C=2 mA$, $V_{CC}=10V$
	Rise Time	t,		15			(Circuit No. 1)
	Storage Time	t _s		0.1			
	Fall Time	t _f		15			
Saturated				_			$R_L=2 K\Omega$, $I_F=15 mA$, $V_{CC}=5 V$
t on (from 5 V to 0.8 V) t off (from SAT to 2.0 V)		ton (SAT)		5		μs	R _B =open (Circuit No. 2)
		toff (SAT)		25			VB - oben (chean vo)
Saturated						115	R ₁ = 2 KΩ, I _F = 20 mA, V _{CC} = 5 V
t on (from 5		t _{on} (SAT)		5		μs	$R_B=100 \text{ K}\Omega \text{ (Circuit No. 2)}$
	AT to 2.0 V)	toff (SAT)		18			MB 100 / MS (Direction 1)
Non-Saturated				175		ns	$R_{I} = 1 K\Omega$, $V_{CB} = 10 V$
Base	Rise Time	t,		175 175		ns	
	Fall Time	t _f		1/3			V





TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

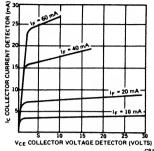


Fig. 1 Collector Current vs. Collector Voltage (for Typical CTR 30%)

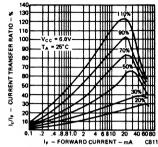


Fig. 2 Current Transfer Ratio vs. Forward Current

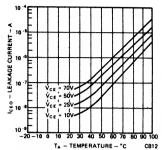


Fig. 3 Dark Current vs. Temperature

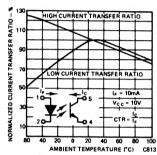


Fig. 4 Current Transfer Ratio vs. Temperature

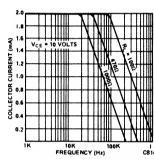


Fig. 5 Collector Current vs. Frequency

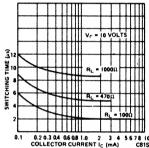


Fig. 6 Switching Time vs. Collector

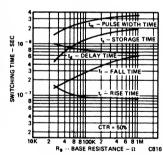


Fig. 7 Switching Time vs. Base Resistance

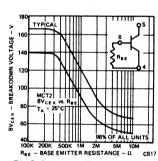


Fig. 8 Collector – Emitter Breakdown Voltage vs. Base Resistance

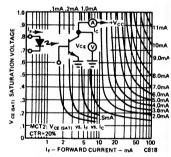


Fig. 9 Saturation Voltage vs. Forward Current

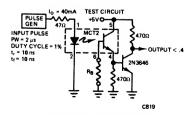


Fig. 10 Circuit for Figure 7

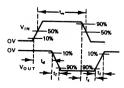


Fig. 11 Waveforms for Figure 7

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25° C Free Air Temperature Unless Otherwise Specified)

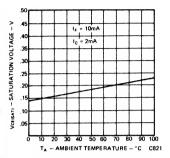


Fig. 12. Saturation Voltage vs. Temperature

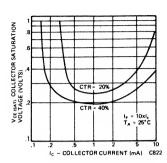


Fig. 13. Saturation Voltage vs. Collector Current

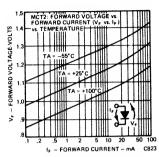


Fig. 14. Forward Voltage vs. Forward Current

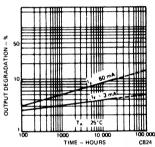


Fig. 15. Lifetime vs. Forward Current (Note 4)

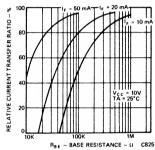


Fig. 16. Sensitivity vs. Base Resistance

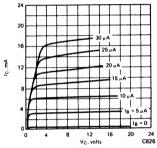
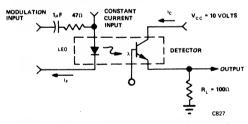
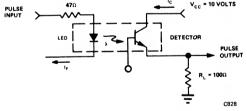


Fig. 17. Detector Typical hfe Curves

OPERATING SCHEMATICS



Modulation Circuit Used to Obtain Output vs Frequency Plot



Circuit Used to Obtain Switching Time vs Collector Current Plot

NOTES

1. The current transfer ratio ($I_{\mathbb{C}}/I_{\mathbb{F}}$) is the ratio of the detector collector current to the LED input current with $V_{\mathbb{C}}$ E at 10 volts.

- 2. The frequency at which i_c is 3 dB down from the 1 kHz value.
- Rise time (t_f) is the time required for the collector current to increase from 10% of its final value, to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value, to 10%.
- 4. Normalized CTR degradation = $\frac{CTR_O CTR}{CTR_O}$

GENERAL INSTRUMENT Optoelectronics

MCT210 PHOTOTRANSISTOR OPTOISOLATOR

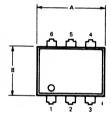
FEATURES

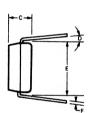
- TTL compatible 1-10 gate loads
- High CTR with transistor output MCT210-150% min.
- Specified CTR over temperature range
- Good logic load characteristics Vol = 0.4 V @ 1.6 mA to 16 mA output sinking (I_{OL})
- UL recognized (File #50151)

APPLICATIONS

- Digital logic isolation
- Line receivers
- Feedback control circuits
- Monitoring circuits

PACKAGE DIMENSIONS

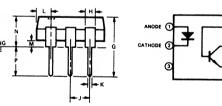






5) COLLECTOR A) EMITTER

C1339



PRODUCT DESCRIPTION

The MCT210 incorporates a NPN silicon planar phototransistor optically coupled to a gallium arsenide diode emitter. The MCT210 has a specified minimum CTR of 50%, saturated, and 150%, unsaturated. This unit is mounted in a six-lead plastic DIP socket.

SYMBOL	INCH MAX.		NOTES
A B C D	.365	9.27	
8	.270	6.73	1
С	.130	3.18	1
Ð	15°	15°	
É	.300 Ref	7.62 Ref	1
F	.014	0.36	
G	.325	8.26	
н	.070	1.78	
J	.110	2.79	
ĸ	.022	0.56	
L.	.085	2.16	2
M			3
N	.175	4.45	4
P			3

- NOTES
 1. Installed position of lead centers
 2. Four places
 3. Overall installed position
 4. These measurements are made from the seating plane

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature55°C to 150°C
Operating temperature55°C to 100°C
Lead temperature (Soldering, 10 sec)
Total package power dissipation @ 25°C (LED plus detector)
Derate linearly from 25°C 3.4 mW/°C
Surge isolation
Steady state isolation

INPUT DIODE

HI OT DIODE
Forward current 60 mA
Reverse voltage
Peak forward current
(1 μs pulse, 300 pps)
Power dissipation 25°C to 70°C ambient 90 mW
Derate linearly from +70°C 2.0 mW/°C
A

OUTPUT TRANSISTOR

Power dissipation @ 25°C	***
Derate linearly from 25°C	200 mW
carryc 25 C	2.67 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (0° to +70°C Temperature unless otherwise specified)

	IN	DIVIDUAL C	OMPONE	NT CHAP	RACTER	RISTICS	
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
NPUT DIODE	Forward voltage Forward voltage temp. coefficient	V _F		1.25 -1.8	1.50	mV/°C	I _F = 40 mA
5	Reverse breakdown voltage	BV _R	6.0	15		V	i _R = 10 μA
4	Junction capacitance	Cرَ		50		pΕ	$V_F = 0 V, f = 1 MHz$
=				65	10	pF μΑ	V _F = 1 V, f = 1 MHz
	Reverse leakage current	I _R		.01	10	μΑ	V _R = 6.0 V
	DC forward current gain Breakdown voltage	h _{FE}		400			V _{CE} = 5 V, I _C = 10 mA
Œ	Collector to emitter	BVCEO	30	45		V.	I _C = 1.0 mA, I _F = 0
2	Collector to base	ВУсво	70	8		V	$I_C = 10 \mu A$ $I_F = 100 \mu A, I_F = 0$
SIS	Emitter to collector	BV _{ECO}	6	٥		V	τ <u>ε</u> – 100 μπ, τ ε – 0
OUTPUT TRANSISTOR	Leakage current Collector to emitter	I _{CEO}		5	50	nΑ	$V_{CE} = 5 \text{ V, I}_{F} = 0,$ $T_{A} = +25 ^{\circ}\text{C}$
PUT	Capacitance				30	μΑ	$V_{CE} = 5 \text{ V, I}_{F} = 0,$
5	Collector to emitter			8		pF	$V_{CE} = 0$, $f = 1 MHz$
ō	Collector to base			20		pF	V _{CB} = 5, f = 1 MHz
	Emitter to base			10		pF	V _{EB} = 0, f = 1 MHz
		COUPL	ED CHA	RACTER	ISTICS		
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
	Current transfer ratio, collector to emitter	I _{CE} /I _F					
	MCT210 (a)		50	70		%	V _{CE} = 0.4 V, I _F = 3.2 mA to 32 mA
2			150	225		%	$V_{CE} = 5.0 \text{ V}, I_F = 10 \text{ mA}$
	Current transfer ratio, collector to base	I _{CB} /I _F		0.6		%	$V_{CB} = 5.0 \text{ V}, I_F = 10 \text{ mA}$
	Saturation voltage	V _{CE(SAT)}					
	collector to emitter MCT210			0.2	0.4	V	I _C = 16 mA, I _F = 32 mA
	Surge isolation	V _{iso}	2500			VDC	Relative humidity \leq 50%, T _A = +25°C, I _{I-O} \leq 10 μ A
İ			1500			VAC-rms	1 second
SOLATION	Steady state isolation	V_{iso}	2250			VDC	Relative humidity \leq 50%, T _A = +25°C, I _{I-O} \leq 10 μ A
1			1250			VAC-rms	1 minute
SS	Isolation resistance	R_{iso}	1011	5×10 ¹²		ohms	V _{I-O} = 500 VDC, T _A = +25°C
	Isolation capacitance	Ciso		1.0		pF	f=1 MHz
	Non-saturated					μs	$R_L = 100 \Omega$, $I_C = 2 \text{mA}$,
MES	Rise time	t _r		4		•	V _{CC} = 5 V
SWITCHING TIMES	Fall time	t _i		5		μs	See Figures 17 and 18
×	Saturated Bise time	t.		2.5		μs	$R_L = 560 \Omega$, $I_F = 16 \text{mA}$
I X	Rise time Fall time	t _r		25		μs	See Figures 17 and 18
IE	Propagation delay	•		_		**=	R _L = 2.7K, I _F = 16 mA
NS.	High to low	T _{PD(HL)}		2		μs μs	See Figures 17 and 18
1	Low to high	T _{PD(LH)}		10		h2	

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

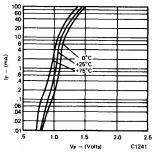


Fig. 1. Forward Voltage vs. Forward Current

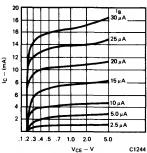


Fig. 4. Collector Current vs. Collector to Emitter Voltage

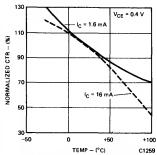


Fig. 7. Current Transfer Ratio (saturated) vs. Temperature

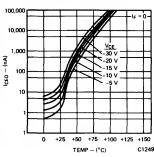


Fig. 10. Collector to Emitter Leakage Current vs. Temperature

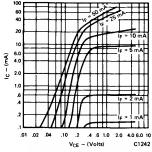


Fig. 2. Collector Current vs. Collector to Emitter Voltage

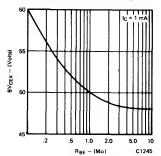


Fig. 5. Collector to Emitter Breakdown Voltage vs. Base to Emitter Resistance

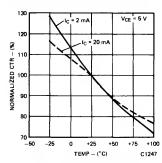


Fig. 8. Current Transfer Ratio (unsaturated) vs. Temperature

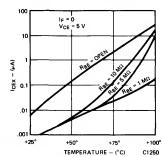


Fig. 11. Collector to Emitter Leakage Current vs. Temperature

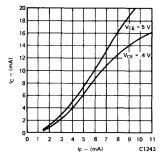


Fig. 3. Collector Current vs. Forward Current

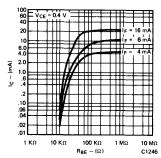


Fig. 6. Saturated CTR vs. Base to Emitter Resistance

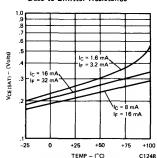


Fig. 9. Collector to Emitter Saturation Voltage vs. Temperature

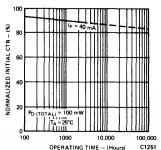


Fig. 12. Current Transfer Ratio vs. Operating Time

SWITCHING CHARACTERISTICS

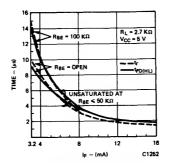


Fig. 13. Switch-on Time vs. IF Drive (saturated)

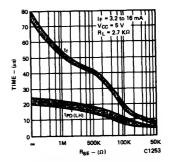


Fig. 14. Switch-off Time vs. Bese to Emitter Resistance (saturated)

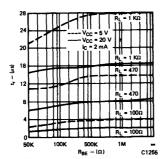


Fig. 15. Rise Time vs. Base to Emitter Resistance (non-saturated)

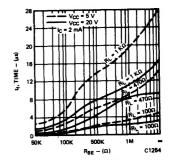


Fig. 16. Fall Time vs. Bese to Emitter Resistance (non-seturated)

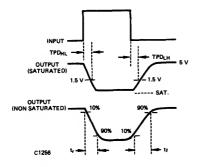


Fig. 17. Switching Time Weveforms

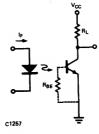


Fig. 18. Switching Time Test Circuits

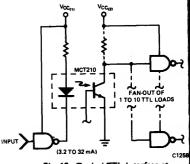


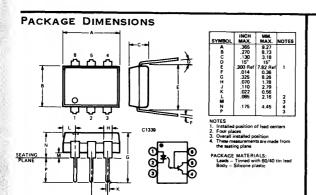
Fig. 19. Typicel TTL Interface at Operating Temperatures of 0° to 70° C

GENERAL INSTRUMENT Optoelectronics

MCT26 PHOTOTRANSISTOR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCT26 is a NPN silicon planar phototransistor optically coupled to a gallium arsenide diode. It is mounted in a six lead plastic DIP.



APPLICATIONS

- AC line/digital logic isolator
- Digital logic/digital logic isolator
- Telephone/telegraph line receiver
- Twisted pair line receiver
- High frequency power supply feedback control
- Relay contact monitor
- Power supply monitor

ABSOLUTE MAXIMUM RATINGS

Storage Temperature -55°C to 150°C Operating temperature -55°C to 100°C Lead temperature (Soldering, 10 sec) 260°C

 Output Transistor
Power Dissipation at 25°C ambient ... 200 mW
Derate linearly from 25°C ... 2.6 mW/°C
Input to output voltage 1500 volts
Total package power dissipation at
25°C ambient (LED plus detector) . . . 250 mW
Derate linearly from 25°C 3.3 mW/°C

ELECTRO-OPTICAL CHARACTI	ERISTICS	(25°C Fre	e Air Tem	perature Unless (Otherwise Specified)
CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Emitter					
Forward voltage V _F	_	1.25	1.5	V	I _E = 20 mA
Reverse current IR	_	.15	10	μΑ	$V_{\rm R} = 3.0 \text{ V}$
Capacitance C	_	50	_	pF	V = 0
Detector					
h _{FE}		150	_		$V_{CE} = 5 \text{ V}, I_{C} = 100 \mu\text{A}$
BV _{CEO}	30	85	_	V	IC = 1.0 mA, I _F = 0
BVECO	7	12	_	V	$I_{\rm E} = 100 \mu A$, $I_{\rm E} = 0$
CEO	-	5	100	nΑ	V _{CE} = 5 V, I _F = 0
Capacitance Collector-emitter C _{CF}	_	8	_	pF	V _{CE} = 0
BV _{CBO}	30	165	_	V	$I_C = 10 \mu\text{A}$
I _{CBO} (dark)	_	1	100	nA	$V_{CB} = 5 V, I_F = 0$
Coupled DC current transfer ratio CTR		1.4		•	
Breakdown voltage	6	14	_	% \\DC	$I_{\rm F} = 10 \text{mA}, V_{\rm CE} = 10 \text{V}, \text{note } 1$
breakdown vortage	1500 800	2500	_	VDC	t = 1 second
Posistanse emitter detector C	1011	10 ¹²		0	VAC, RMS @ f = 60 Hz
Resistance emitter-detector R _{I-O}	10			Ω	V _{E-O} = 500 VDC
V _{CE} (SAT)	_	0.2	0.3	V	$I_{C} = 250 \mu\text{A}, I_{F} = 20 \text{mA}$
	_	0.2	0.5	V	$I_{C} = 1.6 \text{ mA}, I_{F} = 60 \text{ mA}$
Capacitance LED to detector C _{I-O}	_	0.5	_	pF	f = 1 MHz
Bandwidth (see figure 5) B _w		300	_	kHz	$I_C = 2 \text{ mA, note } 2$
Rise time + fall time (see oper. scher	natics) t _r l _f	2	_	μs	$I_{C} = 2 \text{ mA}, V_{CE} = 10 \text{ V}, \text{ note 3}$

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

and the second s

(25°C Free Air Temperature Unless Otherwise Specified)

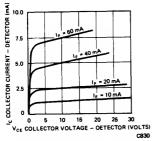


Fig. 1 Detector Output Characteristics

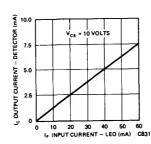


Fig. 2 Input Current vs. Output Current

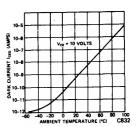


Fig. 3 Dark Current vs. Temperature (°C)

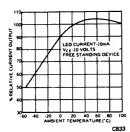


Fig. 4 Current Output vs. Temperature

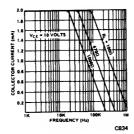


Fig. 5 Output vs. Frequency

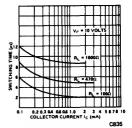
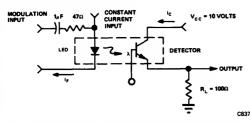


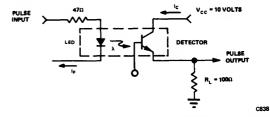
Fig. 6 Switching Time vs. Collector Current

For additional characteristic curves, see figures 2, 3, 5, 6, 8, 11, 12, & 13 on MCT2.

OPERATING SCHEMATICS



Modulation Circuit Used to Obtain Output vs. Frequency Plot



Circuit Used to Obtain Switching Time vs. Collector Current Plot

NOTES

- The current transfer ratio (IC/IF) is the ratio of the detector collector current to the LED input current with VCF at 10 volts.
- 2. The frequency at which i_c is 3 dB down from the 1 kHz value.
- Rise time (t_r) is the time required for the collector current to increase from 10% of its final value to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

GENERAL INSTRUMENT Optoelectronics

DESIGNER SERIES

MCT271 PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

- Controlled Current Transfer Ratio 45% to 90% (specified conditions)
- Maximum Turn-on time 7 μseconds (specified condition)
- Maximum Turn-off time 7 μseconds (specified condition)
- Surge Isolation Rating 3550 volts DC 2500 volts AC, rms
- Steady-state Isolation Rating 3150 volts DC 2250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized
 File E50151

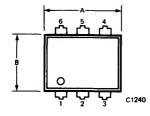
DESCRIPTION

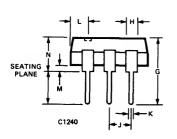
The MCT271 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

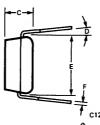
APPLICATIONS

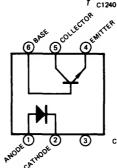
- Switching networks
- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems

PACKAGE DIMENSIONS









SYMBOL	INCHES	mm	NOTES
STMBUL	MAX.	MAX.	NUTES
Α	.365	9.27	
В	.270	6.73	
С	.130	3.18	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	1
F	.014	0.36	
G	.325	8.26	
н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
М			3
N	.175	4.45	4
Р			3

NOTES

- 1. INSTALLED POSITION OF LEAD CENTERS
- 2. FOUR PLACES
- 3. OVERALL INSTALLED POSITION
 4. THESE MEASUREMENTS ARE MADE FROM THE
- SEATING PLANE

C1109

(A) \$1/4/00 [5] 预生的

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

	TRANSFER CHARACTERISTICS											
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS					
oc	Current Transfer Ratio, collector to emitter (a)	I _{CE} /I _F	45 12.5	67	90	% %	I _F = 10 mA; V _{CE} = 10 V I _F = 16 mA; V _{CE} = 0.4 V					
	Current Transfer Ratio, collector to base Saturation voltage	I _{CB} /I _F V _{CE} (SAT)		.15 .14	.40	% V	I _F = 10 mA; V _{CB} = 10 V I _F = 16 mA; I _C = 2 mA					
Si	Non-saturated Turn-on time	ton		4.9	7	μs	$R_L = 100 \Omega; I_C = 2 mA;$ $V_{CC} = 5 V$					
SWITCHING TIMES	Turn-off time	t _{off}		4.5	7	μs	See figures 11, 13					
ING I	Turn-on time	ton		5.2		μs	I_F = 16 mA; R_L = 1.9 KΩ See figures 12, 14					
E E	Turn-off time (Approximates a typical T	t _{off} TL interface)		38		μs						
SW	Turn-on time Turn-off time	^t on ^t off		4.9 90		μs μs	$I_F = 16 \text{ mA}; R_L = 4.7 \text{ K}\Omega$ See figures 12, 14					
	(Approximates a typical le		face)									
	Surge isolation	Viso	3550			VDC	Relative humidity $\leq 50\%$, $I_{1-O} \leq 10 \mu A$					
SOLATION	Steady state isolation	V _{iso}	2500 3150			VAC-rms VDC	1 second Relative humidity \leq 50%, $I_{I-O} \leq$ 10 μ A					
ISOL	Isolation resistance	R _{iso}	2250 10 ¹¹			VAC-rms ohms	1 minute V _{I-O} = 500 VDC					
	Isolation capacitance	C _{iso}		.5		ρF	f = 1 MHz					

	INDIVIDUAL COMPONENT CHARACTERISTICS											
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS					
w [Forward voltage	V _F		1.20	1.50	٧	I _F = 20 mA					
DIODE	Forward voltage temp.											
	coefficient			-1.8		mV/°C						
PPCT	Reverse breakdown voltage	B∨ _R	3.0	25		V	I _R = 10 μA					
<u>آ</u>	Junction capacitance	CJ		50		ρF	$V_F = 0 V$, $f = 1 MHz$					
=				65		ρF	$V_F = 1 V, f = 1 MHz$					
- 1	Reverse leakage current	۱R		.35	10	μΑ	V _R = 3.0 V					
\dashv	DC forward current gain	hFE	100	420			V _{CE} = 5 V, I _C = 100 μA					
_	Breakdown voltage	_										
5 I	Collector to emitter	BVCEO	30	45		V	$I_C = 1.0 \text{ mA}, I_F = 0$					
ĒΙ	Collector to base	BVCBO	70	130		V	I _C = 10 μA					
2	Emitter to collector	BVECO	7	10		V	$I_E = 100 \mu A, I_F = 0$					
₹ I	Leakage current											
T TRANSISTOR	Collector to emitter	CEO		5	50	nΑ	$V_{CE} = 10 \text{ V, } I_F = 0$					
OUTPUT	Capacitance											
5	Collector to emitter			8		ρF	$V_{CE} = 0$, f = 1 MHz					
ō	Collector to base			20		ρF	V _{CB} = 5, f = 1 MHz					
	Emitter to base			10		pF	$V_{EB} = 0$, $f = 1$ MHz					

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

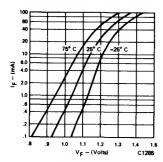


Fig. 1. Forward Voltage vs.

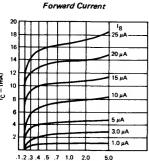


Fig. 4. Collector Current vs. Collector to Emitter Voltage

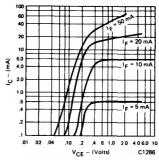


Fig. 2. Collector Current vs. Collector to Emitter Voltage

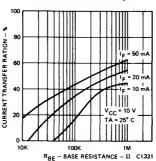


Fig. 5. Sensitivity vs. Base Resistance

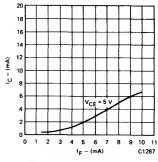


Fig. 3. Collector Current vs. Forward Current

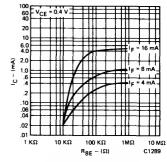
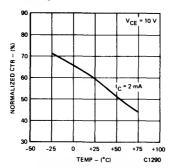


Fig. 6. Saturated CTR vs. Base to Emitter Resistance



C1288

Fig. 7. Current Trensfer Retio (unsatureted) vs. Tempereture

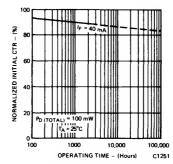


Fig. 8. Current Transfer Ratio vs. Opereting Time

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature55 C	to 150 C
Operating temperature55°C	to 100°C
Lead temperature	
(Soldering, 10 sec)	. 260°C
Total package power dissipation @ 25°C	
(LED plus detector)	260 mW
Derate linearly from 25°C 3.	5 mW/°C

INPUT DIODE

Forward DC current	mA
Reverse voltage	3 V
Peak forward current	
(1 μs pulse, 300 pps)	.0 A
Power dissipation 25°C ambient 90	mW
Derate linearly from 25°C 1.2 mV	N/°C
OUTPUT TRANSISTOR	

Power dissipation @ 25°C.				 200 mW
Derate linearly from 25°C				 . 2.67 mW/°C

SWITCHING CHARACTERISTICS

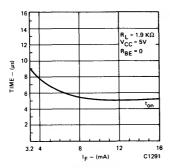


Fig. 9. Switch-on Time vs. If Drive (saturated)

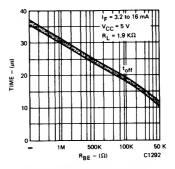


Fig. 10. Switch-off Time vs. Base to Emitter Resistance (saturated)

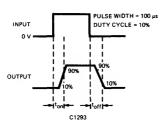


Fig. 11.

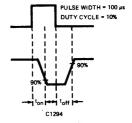


Fig. 12.

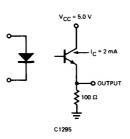


Fig. 13.

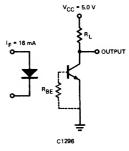


Fig. 14.

GENERAL INSTRUMENT Optoelectronics

DESIGNER SERIES

MCT272

PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

 Controlled Current Transfer Ratio – 75% to 150% (specified conditions)

- 100

- Maximum Turn-on time 10 μseconds (specified condition)
- Maximum Turn-off time 10 μseconds (specified condition)
- Surge Isolation Rating –
 3550 volts DC
 2500 volts AC, rms
- Steady-state Isolation Rating 3150 volts DC 2250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized
 File E50151

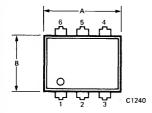
DESCRIPTION

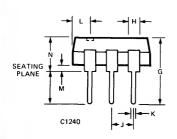
The MCT272 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor. The device is supplied in a standard plastic six-pindual-in-line package.

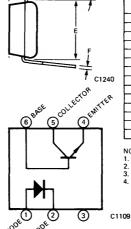
APPLICATIONS

- Power supply regulators
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems
- Power supply regulators
- Industrial controls

PACKAGE DIMENSIONS







SYMBOL	INCHES MAX.	mm MAX.	NOTES
Α	.365	9.27	
В	.270	6.73	
C	.130	3.1B	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	1
F	.014	0.36	
G	.325	B.26	
н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
М			3
N	.175	4.45	4
P			3

NOTES

- 1. INSTALLED POSITION OF LEAD CENTERS
- 2. FOUR PLACES

- CONTROL OF THE RESPONDED TO THE SECOND OF

OVERALL INSTALLED POSITION
 THESE MEASUREMENTS ARE MADE FROM THE SEATING PLANE

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

		TRANSF	ER CHA	RACTE	RISTICS		
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
20	Current Transfer Ratio, collector to emitter (a)	I _{CE} /I _F	75 12.5	115	150	% %	I _F = 10 mA; V _{CE} = 10 V I _F = 16 mA; V _{CE} = 0.4 V
_	Current Transfer Ratio, collector to base Saturation voltage	I _{CB} /I _F V _{CE(SAT)}		.15 .12	.40	% V	I _F = 10 mA; V _{CB} = 10 V I _F = 16 mA; I _C = 2 mA
	Non-saturated Turn-on time	ton		6.0	10	μs	$R_L = 100 \Omega; I_C = 2 mA;$ $V_{CC} = 5 V$
TIMES	Turn-off time	t _{off}		5.5	10	μs	See figures 11, 13
S S	Saturated Turn-on time	ton		3.9		μs	I _F = 16 mA; R _L = 1.9 KΩ
듄	Turn-off time (Approximates a typical 1	toff		48		μs	See figures 12, 14
SWITCHING	Turn-on time	t _{on}		3.9		μs	$I_F = 16$ mA; $R_L = 4.7$ KΩ
•	Turn-off time (Approximates a typical le	t _{off} nw power TTL interf	face)	110		μs	See figures 12, 14
	Surge isolation	V _{iso}	3550		_	VDC	Relative humidity $\leq 50\%$, $I_{1-Q} \leq 10 \mu\text{A}$
SOLATION	Steady state isolation	V _{iso}	2500 3150			VAC-rms VDC	1 second Relative humidity \leq 50%, $I_{1-O} \leq$ 10 μ A
SOLA	Isolation resistance	R _{iso}	2250 10 ¹¹			V AC-rms ohms	1 minute V _{I-O} = 500 VDC
	Isolation capacitance	C _{iso}		.5		pF	f = 1 MHz

	INDIVIDUAL COMPONENT CHARACTERISTICS											
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS					
ᆈ	Forward voltage	V _F		1.20	1.50	٧	I _F = 20 mA					
DIODE	Forward voltage temp.					_						
	coefficient			-1.8		mV/°C						
INPUT	Reverse breakdown voltage	B∨R	3.0	25		V	I _R = 10 μA					
₹	Junction capacitance	C _J		50		рF	$V_F = 0 V, f = 1 MHz$					
=		-		65		рF	$V_F = 1 V, f = 1 MHz$					
	Reverse leakage current	I _R		.35	10	μΑ	V _R = 3.0 V					
	DC forward current gain	h _{FE}	100	500			V _{CE} = 5 V, I _C = 100 μA					
1	Breakdown voltage											
6	Collector to emitter	BV _{CEO}	30	45		V	$I_C = 1.0 \text{ mA}, I_F = 0$					
S	Collector to base	BVCBO	70	130		V	I _C = 10 μA					
TRANSISTOR	Emitter to collector	BVECO	7	10		٧	$I_E = 100 \mu A, I_F = 0$					
Ž	Leakage current											
	Collector to emitter	CEO		5	50	nΑ	$V_{CE} = 10 \text{ V, I}_{F} = 0$					
OUTPUT	Capacitance											
Ę	Collector to emitter			8		рF	$V_{CE} = 0$, $f = 1 MHz$					
ŏ	Collector to base			20		pF	V _{CB} = 5, f = 1 MHz					
	Emitter to base			10		pF	V _{EB} = 0, f = 1 MHz					

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

AND THE PROPERTY OF THE PROPER

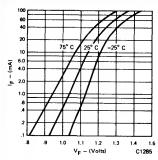


Fig. 1. Forward Voltage vs. Forward Current

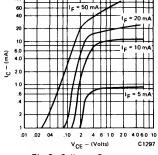


Fig. 2. Collector Current vs. Collector to Emitter Voltage

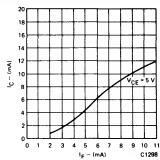


Fig. 3. Collector Current vs. Forward Current

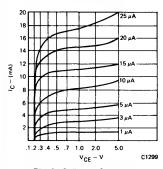


Fig. 4. Collector Current vs. Collector to Emitter Voltage

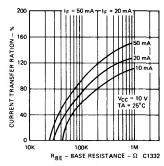


Fig. 5. Sensitivity vs. Base Resistance

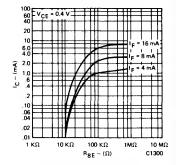


Fig. 6. Saturated CTR vs. Base to Emitter Resistance

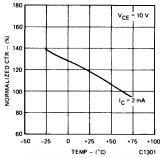


Fig. 7. Current Transfer Ratio (unsaturated) vs. Temperature

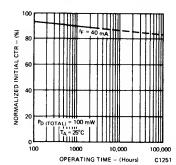


Fig. 8. Current Transfer Ratio vs. Operating Time

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE
Storage temperature55°C to 150°C Operating temperature55°C to 100°C
Operating temperature55°C to 100°C
Lead temperature
(Soldering, 10 sec)
Total package power dissipation @ 25°C
(LED plus detector) 260 mW
Derate linearly from 25°C 3.5 mW/°C

INPUT DIODE

Forward DC current												. (60	mΑ
Reverse voltage														3 V
Peak forward current														
(1 μs pulse, 300 pps)														
Power dissipation 25°	C	an	nŁ	ρíε	ent	t						٤	90	mΨ
Derate linearly from 2	25°	C	;							1	.2	r	n۷	//°C
OUTDUT TO AMOUNT	_	_												

OUTPUT TRANSISTOR

Power dissipation @ 25°C.					
Derate linearly from 25°C					2.67 mW/°C

SWITCHING CHARACTERISTICS

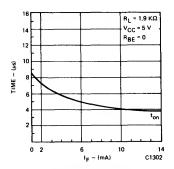


Fig. 9. Switch-on Time vs. IF Drive (saturated)

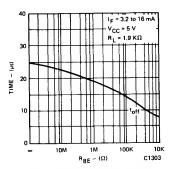


Fig. 10. Switch-off Time vs. Base to Emitter Resistance (saturated)

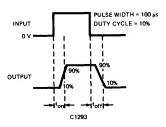


Fig. 11.

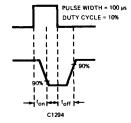
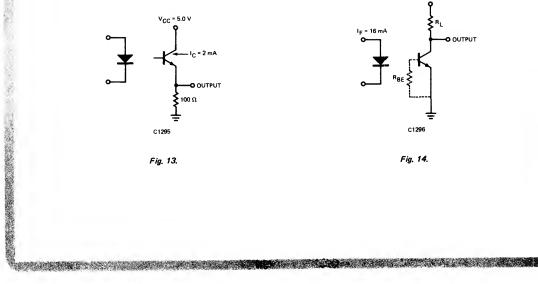
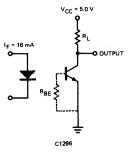


Fig. 12.





GENERAL INSTRUMENT Optoelectronics

DESIGNER SERIES

MCT273 PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

- Controlled Current Transfer Ratio 125% to 250% (specified conditions)
- Maximum Turn-on time 20 μseconds (specified condition)
- Maximum Turn-off time 20 μseconds (specified condition)
- Surge Isolation Rating 3550 volts DC 2500 volts AC, rms
- Steady-state Isolation Rating 3150 volts DC 2250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized
 File E50151

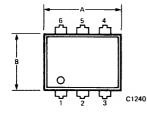
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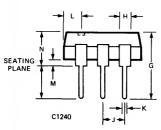
The MCT273 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

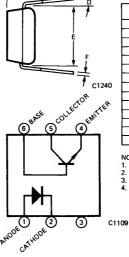
APPLICATIONS

- Microprocessor board, reversible input/output
- Sensors to logic
- Logic to controls
- Appliance controls
- Industrial process control systems

PACKAGE DIMENSIONS







SYMBOL	INCHES	mm	NOTES
STMBOL	MAX.	MAX.	NOTES
Α	.365	9.27	
В	.270	6.73	
С	.130	3.18	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	1
F	.014	0.36	
G	.325	8.26	
Н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
M			3
N	.175	4.45	4
P			3

NOTES

- 1. INSTALLED POSITION OF LEAD CENTERS
- 2. FOUR PLACES
- 3. OVERALL INSTALLED POSITION
 4. THESE MEASUREMENTS ARE MADE FROM THE SEATING PLANE

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

		TRANSF	ER CHA	RACTE	RISTICS		
_	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
	Current Transfer Ratio,						
	collector to emitter (a)	ICE/IF	125	200	250	%	I _F = 10 mA; V _{CE} = 10 V
			12.5			%	I _F = 16 mA; V _{CE} = 0.4 V
	Current Transfer Ratio,						
	collector to base	I _{CB} /I _F		.15		%	I _F = 10 mA; V _{CB} = 10 V
	Saturation voltage	V _{CE(SAT)}		.20	.40	V	I _F = 16 mA; I _C = 2 mA
l	Non-saturated						
	Turn-on time	ton		7.6	20	μs	$R_L = 100 \Omega; I_C = 2 \text{mA};$
				6.6	20		V _{CC} = 5 V See figures 11, 13
	Turn-off time Saturated	^t off		6.6	20	μs	See rigures (1, 13
	Turn-on time	•		3.6		μς	I _F = 16 mA; R _L = 1.9 KS
	Turn-off time	t _{on} t _{off}		75		μs	See figures 12, 14
	(Approximates a typical TT					•	
	Turn-on time	ton		3.6		μs	I _F = 16 mA; R _L = 4.7 KS
	Turn-off time	toff		155		μs	See figures 12, 14
	(Approximates a typical lov	w power TTL inter	face)				
	Surge isolation	V _{iso}	3550			VDC	Relative humidity ≤ 50%
							$I_{i-O} \leq 10 \mu\text{A}$
			2500			VAC-rms	1 second
	Steady state isolation	V _{iso}	3150			VDC	Relative humidity ≤ 50%
ì	1		2250			VAC-rms	I _{I−O} ≤ 10 μA 1 minute
SOLATION	Isolation resistance	ο.	10 ¹¹			ohms	V _{I-O} = 500 VDC
	Isolation resistance	R_{iso}	10			Omma	VI.O 300 130
	Isolation capacitance	C _{iso}		.5		pF	f = 1 MHz
	11	NDIVIDUAL CO	OMPONE	NT CHA	RACTER	RISTICS	
_			OMPONEN	NT CHA	RACTER MAX.	RISTICS	TEST CONDITIONS
	CHARACTERISTIC	SYMBOL		TYP.	MAX.	UNITS	
							TEST CONDITIONS
	CHARACTERISTIC Forward voltage	SYMBOL		TYP.	MAX.	UNITS	
	CHARACTERISTIC Forward voltage Forward voltage temp.	SYMBOL		TYP. 1.20 -1.8 25	MAX.	UNITS	I _F = 20 mA
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient	SYMBOL V _F	MIN.	TYP. 1.20 -1.8 25 50	MAX.	V mV/°C V pF	I _F = 20 mA I _R = 10 μA V _F = 0 V, f = 1 MHz
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance	SYMBOL V _F BV _R C _J	MIN.	TYP. 1.20 -1.8 25 50 65	MAX. 1.50	UNITS V mV/°C V pF pF	I _F = 20 mA I _R = 10 μA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current	SYMBOL V _F BV _R C _J I _R	MIN.	TYP. 1.20 -1.8 25 50 65 .35	MAX.	V mV/°C V pF	$I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{V, f} = 1 \text{MHz}$ $V_F = 1 \text{V, f} = 1 \text{MHz}$ $V_R = 3.0 \text{V}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain	SYMBOL V _F BV _R C _J	MIN.	TYP. 1.20 -1.8 25 50 65	MAX. 1.50	UNITS V mV/°C V pF pF	I _F = 20 mA I _R = 10 μA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage	SYMBOL VF BVR CJ IR hFE	MIN. 3.0	1.20 -1.8 25 50 65 .35 280	MAX. 1.50	UNITS V mV/°C V pF pF μA	I_F = 20 mA I_R = 10 μ A V_F = 0 V, f = 1 MHz V_F = 1 V, f = 1 MHz V_R = 3.0 V V_C E = 5 V, I_C = 100 μ A
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter	SYMBOL VF BVR CJ IR hFE BVCEO	3.0 3.0	TYP. 1.20 -1.8 25 50 65 .35 280	MAX. 1.50	UNITS V mV/°C V pF pF	$I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{ V, f} = 1 \text{ MHz}$ $V_F = 1 \text{ V, f} = 1 \text{ MHz}$ $V_R = 3.0 \text{ V}$ $V_{CE} = 5 \text{ V, I}_{C} = 100 \mu\text{A}$ $I_C = 1.0 \text{ mA, I}_F = 0$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage	SYMBOL VF BVR CJ IR hFE	MIN. 3.0	1.20 -1.8 25 50 65 .35 280	MAX. 1.50	V mV/°C V pF pF μA	I_F = 20 mA I_R = 10 μ A V_F = 0 V, f = 1 MHz V_F = 1 V, f = 1 MHz V_R = 3.0 V V_C E = 5 V, I_C = 100 μ A
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base	SYMBOL VF BVR CJ IR hFE BVCEO BVCBO	3.0 30 70	TYP. 1.20 -1.8 25 50 65 .35 280 70 170 12	MAX. 1.50	UNITS V mV/°C V pF pF μA V V	$\begin{split} I_F &= 20 \text{ mA} \\ I_R &= 10 \ \mu\text{A} \\ V_F &= 0 \ V, \ f = 1 \ \text{MHz} \\ V_F &= 1 \ V, \ f = 1 \ \text{MHz} \\ V_R &= 3.0 \ V \\ VCE &= 5 \ V, \ I_C &= 100 \ \mu\text{A} \\ I_C &= 1.0 \ \text{mA}, \ I_F &= 0 \\ I_C &= 10 \ \mu\text{A}, \ I_F &= 0 \end{split}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector	SYMBOL VF BVR CJ IR hFE BVCEO BVCBO	3.0 30 70	TYP. 1.20 -1.8 25 50 65 .35 280 70 170	MAX. 1.50	UNITS V mV/°C V pF pF μA	$I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{ V, } f = 1 \text{ MHz}$ $V_F = 1 \text{ V, } f = 1 \text{ MHz}$ $V_R = 3.0 \text{ V}$ $V_{CE} = 5 \text{ V, } I_C = 100 \mu\text{A}$ $I_C = 1.0 \text{ mA, } I_F = 0$ $I_C = 10 \mu\text{A}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter	SYMBOL VF BVR CJ IR hFE BVCEO BVCBO BVECO	3.0 30 70	TYP. 1.20 -1.8 25 50 65 .35 280 70 170 12	MAX. 1.50	UNITS V mV/°C V pF pF μA V V	$\begin{split} I_F &= 20 \text{ mA} \\ I_R &= 10 \ \mu\text{A} \\ V_F &= 0 \ V, \ f = 1 \ \text{MHz} \\ V_F &= 1 \ V, \ f = 1 \ \text{MHz} \\ V_R &= 3.0 \ V \\ VCE &= 5 \ V, \ I_C &= 100 \ \mu\text{A} \\ I_C &= 1.0 \ \text{mA}, \ I_F &= 0 \\ I_C &= 10 \ \mu\text{A}, \ I_F &= 0 \end{split}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter Collector to emitter	SYMBOL VF BVR CJ IR hFE BVCEO BVCBO BVECO	3.0 30 70	TYP. 1.20 -1.8 25 50 65 .35 280 70 170 12 5	MAX. 1.50	UNITS V mV/°C V pF pF μA V V V	$\begin{split} I_F &= 20 \text{ mA} \\ I_R &= 10 \mu\text{A} \\ V_F &= 0 \text{V, f} = 1 \text{MHz} \\ V_F &= 1 \text{V, f} = 1 \text{MHz} \\ V_R &= 3.0 \text{V} \\ \end{split} \\ V_{CE} &= 5 \text{V, I}_C = 100 \mu\text{A} \\ I_C &= 1.0 \text{mA, I}_F = 0 \\ I_C &= 10 \mu\text{A}, I_F = 0 \\ \end{split}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter Collector to emitter Collector to emitter Collector to emitter	SYMBOL VF BVR CJ IR hFE BVCEO BVCBO BVECO	3.0 30 70	TYP. 1.20 -1.8 25 50 65 .35 280 70 170 12 5	MAX. 1.50	UNITS V mV/°C V pF pF μA V V V	$I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{ V, } f = 1 \text{ MHz}$ $V_F = 1 \text{ V, } f = 1 \text{ MHz}$ $V_R = 3.0 \text{ V}$ $V_{CE} = 5 \text{ V, } I_C = 100 \mu\text{A}$ $I_C = 1.0 \text{ mA, } I_F = 0$ $I_C = 100 \mu\text{A}$ $I_E = 100 \mu\text{A}$, $I_F = 0$ $V_{CE} = 10 \text{ V, } I_F = 0$ $V_{CE} = 0, f = 1 \text{ MHz}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter Collector to emitter	SYMBOL VF BVR CJ IR hFE BVCEO BVCBO BVECO	3.0 30 70	TYP. 1.20 -1.8 25 50 65 .35 280 70 170 12 5	MAX. 1.50	UNITS V mV/°C V pF pF μA V V V	$\begin{split} I_F &= 20 \text{ mA} \\ I_R &= 10 \mu\text{A} \\ V_F &= 0 \text{V, f} = 1 \text{MHz} \\ V_F &= 1 \text{V, f} = 1 \text{MHz} \\ V_R &= 3.0 \text{V} \\ \end{split} \\ V_{CE} &= 5 \text{V, I}_C = 100 \mu\text{A} \\ I_C &= 1.0 \text{mA, I}_F = 0 \\ I_C &= 10 \mu\text{A}, I_F = 0 \\ \end{split}$

	INDIVIDUAL COMPONENT CHARACTERISTICS								
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS		
2	Forward voltage	V _F		1.20	1.50	V	I _F = 20 mA		
DIODE	Forward voltage temp.								
	coefficient			-1.8		mV/°C			
INPUT	Reverse breakdown voltage	B∨ _R	3.0	25		V	I _R = 10 μA		
9	Junction capacitance	СJ		50		рF	$V_F = 0 V, f = 1 MHz$		
=				6 5		pF	V _F = 1 V, f = 1 M Hz		
	Reverse leakage current	¹ R		.35	10	μΑ	V _R = 3.0 V		
	DC forward current gain	h _{FE}		280			V _{CE} = 5 V, I _C = 100 μA		
~	Breakdown voltage								
Ö	Collector to emitter	BVCEO	30	70		V	$I_C = 1.0 \text{ mA}, I_F = 0$		
ST	Collector to base	BV _{CBO}	70	170		V	I _C = 10 μA		
TRANSISTOR	Emitter to collector	BVECO	7	12		V	I _E = 100 μA, I _F = 0		
₹	Leakage current								
	Collector to emitter	CEO		5	50	nΑ	V _{CE} = 10 V, I _F = 0		
OUTPUT	Capacitance								
5	Collector to emitter			8		рF	V _{CE} = 0, f = 1 MHz		
0	Collector to base			20		pF	V _{CB} = 5, f = 1 MHz		
	Emitter to base			10		pF	V _{EB} = 0, f = 1 MHz		

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

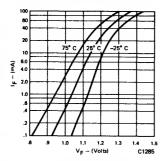


Fig. 1. Forward Voltage vs. Forward Current

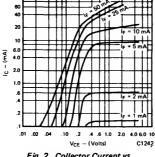


Fig. 2. Collector Current vs. Collector to Emitter Voltage

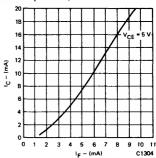


Fig. 3. Collector Current vs. Forward Current

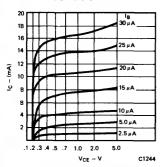


Fig. 4. Collector Current vs. Collector to Emitter Voltage

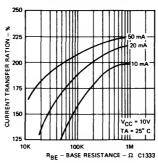


Fig. 5. Sensitivity vs. Base Resistance

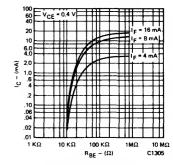


Fig. 6. Saturated CTR vs. Base to Emitter Resistance

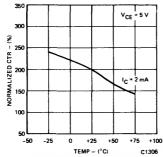


Fig. 7. Current Transfer Ratio (unsaturated) vs. Temperature

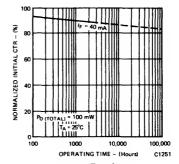


Fig. 8. Current Transfer Ratio vs. Operating Time

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature55°C to 150°	С
Operating temperature55°C to 100°	C,
Lead temperature	
(Soldering, 10 sec)	'C
Total package power dissipation @ 25°C	
(LED plus detector)	W
Derate linearly from 25°C 3.5 mW/°	C

INPUT DIODE

Forward DC current	 60 m	Α
Reverse voltage	 3	٧
Peak forward current		
(1 μs pulse, 300 pps)	 3.0	Α
Power dissipation 25°C ambient	 90 m	W
Derate linearly from 25°C	 . 1.2 mW/	,c

OUTPUT TRANSISTOR

Power dissipation @ 25°C.			
Derate linearly from 25°C	 		 2.67 mW/°C

SWITCHING CHARACTERISTICS

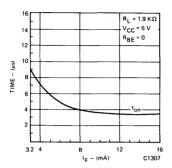


Fig. 9. Switch-on Time vs. IF Drive (saturated)

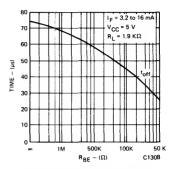


Fig. 10. Switch-off Time vs. Base to Emitter Resistance (saturated)

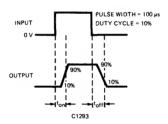


Fig. 11.

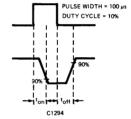


Fig. 12.

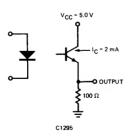


Fig. 13.

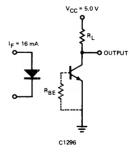


Fig. 14.

GENERAL INSTRUMENT **Optoelectronics**

DESIGNER SERIES

MCT274

PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

- Controlled Current Transfer Ratio 225% to 400% (specified conditions)
- Maximum Turn-on time 25 μseconds (specified condition)
- Maximum Turn-off time 25 μseconds (specified condition)
- Surge Isolation Rating -3550 volts DC 2500 volts AC, rms
- Steady-state Isolation Rating --3150 volts DC 2250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized File E50151

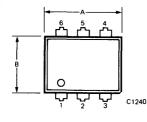
DESCRIPTION

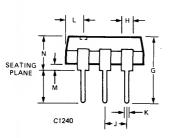
The MCT274 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN high-gain silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

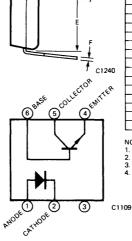
APPLICATIONS

- Control Relays
- Digital controls
- Microprocessor controls
 - Replace slow photodarlington types with better switching speeds and equivalent gain devices
 - Multiple gate interface

PACKAGE DIMENSIONS







SYMBOL	INCHES	mm	NOTES
STWOOL	MAX.	MAX.	NOTES
Α	.365	9.27	
8	.270	6.73	
С	.130	3.18	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	1
F	.014	0.36	
G	.325	8.26	
н	.070	1.78	
J	.110	2.79	
κ	.022	0.56	
L	.085	2.16	2
М			3
N	.175	4.45	4
P			3

NOTES

- 1. INSTALLED POSITION OF LEAD CENTERS
- FOUR PLACES
- 3. OVERALL INSTALLED POSITION
 4. THESE MEASUREMENTS ARE MADE FROM THE SEATING PLANE

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

	TRANSFER CHARACTERISTICS							
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS	
2	Current Transfer Ratio, collector to emitter (a)	I _{CE} /I _F	225 12.5	305	400	% %	I _F = 10 mA; V _{CE} = 10 V I _F = 16 mA; V _{CE} = 0.4 V	
Ī	Current Transfer Ratio, collector to base Saturation voltage	I _{CB} /I _F V _{CE(SAT)}		.15 .16	.40	% V	I _F = 10 mA; V _{CB} = 10 V I _F = 16 mA; I _C = 2 mA	
Si	Non-saturated Turn-on time	ton		9.1	25	μs	$R_L = 100 \Omega; I_C = 2 mA;$ $V_{CC} = 5 V$	
SWITCHING TIMES	Turn-off time Saturated	t _{off}		7.9	25	μs	See figures 11, 13	
ING	Turn-on time	ton		3.0 95		μs μs	$l_F = 16 \text{ mA}; R_L = 1.9 \text{ K}\Omega$ See figures 12, 14	
1TC	Turn-off time (Approximates a typical T	toff TL interface)				,	,	
S	Turn-on time Turn-off time	^t on t _{off}		3.0 185		μs μs	$I_F = 16 \text{ mA}$; $R_L = 4.7 \text{ K}\Omega$ See figures 12, 14	
	(Approximates a typical lo	ow power TTL interf	ace)					
	Surge isolation	V _{iso}	3550			VDC	Relative humidity $\leq 50\%$, $I_{1-O} \leq 10 \mu\text{A}$	
SOLATION	Steady state isolation	V _{iso}	2500 3150			VAC-rms VDC	t = 1 second Relative humidity \leq 50%, $I_{1-\Omega} \leq$ 10 μ A	
ISOL/	Isolation resistance	R _{iso}	2250 10 ¹¹			VAC-rms ohms	t = 1 minute V _{I-O} = 500 VDC	
	Isolation capacitance	C _{iso}		.5		pF	f = 1 MHz	

	INDIVIDUAL COMPONENT CHARACTERISTICS								
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS		
按 [Forward voltage	V _F		1.20	1.50	V	I _F = 20 mA		
DIODE	Forward voltage temp.								
	coefficient			-1.8		mV/°C			
5 1	Reverse breakdown voltage	BVR	3.0	25		V	I _R = 10 μA		
INPUT	Junction capacitance	CJ		50		рF	$V_F = 0 V, f = 1 MHz$		
=				65		рF	$V_F = 1 V, f = 1 MHz$		
	Reverse leakage current	¹ _B		.35	10	μΑ	V _R = 3.0 V		
	DC forward current gain	h _{FE}		360			V _{CE} = 5 V, I _C = 100 μA		
- I	Breakdown voltage								
6 I	Collector to emitter	BV _{CEO}	30	70		V	I _C = 1.0 mA, I _F = 0		
S	Collector to base	BV _{CBO}	70	170		V	I _C = 10 μA		
TRANSISTOR	Emitter to collector	BVECO	7	12		V	$I_E = 100 \mu A, I_F = 0$		
آ ا	Leakage current								
	Collector to emitter	ICEO		5	50	, nA	$V_{CE} = 10 \text{ V, I}_{F} = 0$		
DUTPUT	Capacitance								
5	Collector to emitter			8		рF	$V_{CE} = 0$, $f = 1 MHz$		
0	Collector to base			20		рF	V _{CB} = 5, f = 1 MHz		
	Emitter to base			10		рF	V _{EB} = 0, f = 1 MHz		

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

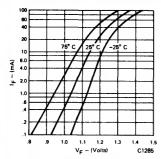


Fig. 1. Forward Voltage vs. Forward Current

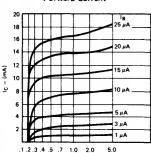


Fig. 4. Collector Current vs. Collector to Emitter Voltage

VCE - V

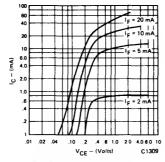


Fig. 2. Collector Current vs. Collector to Emitter Voltage

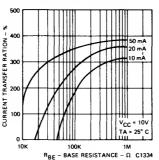
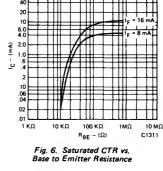


Fig. 5. Sensitivity vs. Base Resistance



5 6

Fig. 3. Collector Current vs.

Forward Current

V_{CE} = 0.4 V

Is - (mA)

10 11

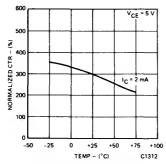
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Fig. 7. Current Transfer Ratio (unsaturated) vs. Temperature

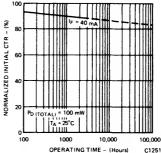


Fig. 8. Current Transfer Ratio vs. Operating Time

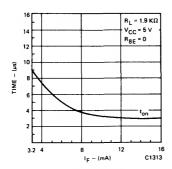
ABSOLUTE MAXIMUM RATINGS

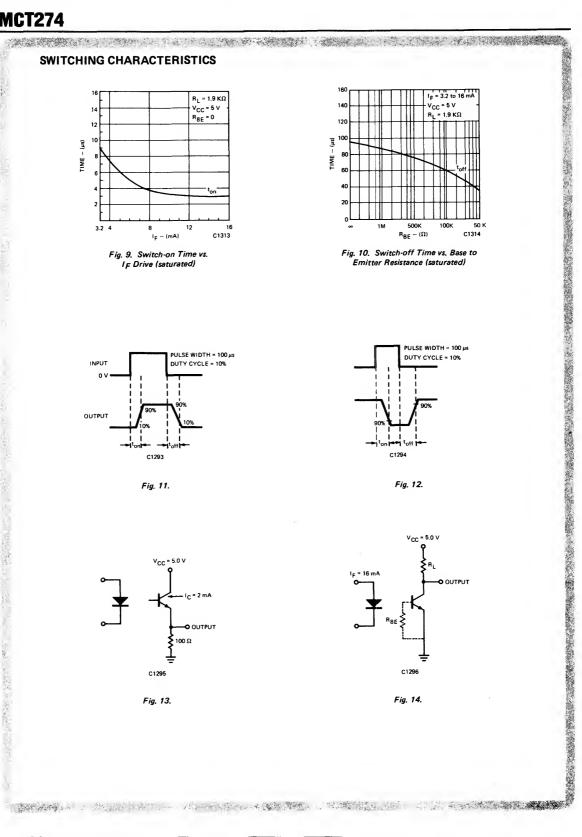
TOTAL PACKAGE

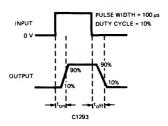
INPUT DIODE

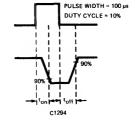
Forward DC current	60 mA
Reverse voltage	3 V
Peak forward current	
(1 μs pulse, 300 pps)	
Power dissipation 25°C ambient	90 mW
Derate linearly from 25°C	. 1.2 mW/°C
OUTPUT TRANSISTOR	
_	

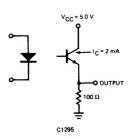
Power dissipation @ 25°C.		200 mW
Derate linearly from 25°C	 	2.67 mW/°C

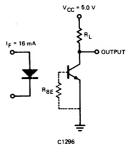












GENERAL INSTRUMENT Optoelectronics

DESIGNER SERIES

MCT275

PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

- High voltage output − 80 volts, BV_{CEO}
- Controlled Current Transfer Ratio 70% to 210% (specified conditions)
- Maximum Turn-on time 15 μseconds (specified condition)
- Maximum Turn-off time 15 μseconds (specified condition)
- Surge Isolation Rating 3550 volts DC 2500 volts AC, rms
- Steady-state Isolation Rating 3150 volts DC 2250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized
 File E50151

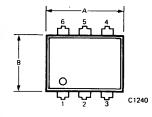
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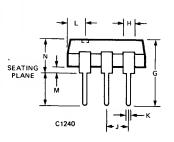
The MCT275 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with a high voltage NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

APPLICATIONS

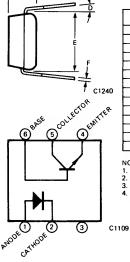
- Telephone circuits
- Digital input to telecommunications
- Industrial control of high DC voltage
- Telephone relay driver

PACKAGE DIMENSIONS





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4471 27 57

SYM8OL	INCHES	mm	NOTES
STIVIBUL	MAX.	MAX.	NOTES
Α	.365	9.27	
8	.270	6.73	
C	.130	3.18	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	11
F	.014	0.36	
G	.325	8.26	
н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
M			3
N	.175	4.45	4
Р			3

NOTES

- 1. INSTALLED POSITION OF LEAD CENTERS
- 2. FOUR PLACES
- 3. OVERALL INSTALLED POSITION
- 4. THESE MEASUREMENTS ARE MADE FROM THE SEATING PLANE

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

		TRANSF	ER CHA	RACTE	RISTICS				
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS		
DC	Current Transfer Ratio,								
	collector to emitter (a)	I _{CE} /I _F	70	125	210	%	I _F = 10 mA; V _{CE} = 10 V		
			12.5			%	I _F = 16 mA; V _{CE} = 0.4 V		
	Current Transfer Ratio,								
	collector to base	I _{CB} /I _F		.15		%	I _F = 10 mA; V _{CB} = 10 V		
ı	Saturation voltage	V _{CE(SAT)}		.25	.40	V	I _F = 16 mA; I _C = 2 mA		
	Non-saturated								
	Turn-on time	ton		4.5	15	μs	$R_L = 100 \Omega; I_C = 2 mA;$		
ES						V _{CC} = 5 V			
SWITCHING TIMES	Turn-off time	toff		3.5	15	μς	See figures 11, 13		
-	Saturated	.							
ž	Turn-on time	ton		3.2		μs	$I_F = 16 \text{ mA}$; $R_L = 1.9 \text{ K}\Omega$		
ᇁ	Turn-off time	toff		50		μς	See figures 12, 14		
7	(Approximates a typical TTL interface)								
3	Turn-on time	ton		3.1		μs	$I_F = 16 \text{ mA; R}_L = 4.7 \text{ K}\Omega$		
0,	Turn-off time	toff		90		μς	See figures 12, 14		
	(Approximates a typical low power TTL interface)								
	Surge isolation	Viso	3550		_	VDC	Relative humidity ≤ 50%,		
ISOLATION		130					I _{I−O} ≤ 10 μA		
			2500			VAC-rms	t = 1 second		
	Steady state isolation	V_{iso}	3150			VDC	Relative humidity ≤ 50%,		
							I _{I−O} ≤ 10 μA		
			2250			VAC-rms	t = 1 minute		
	Isolation resistance	R _{iso}	1011			ohms	V _{I-O} = 500 VDC		
	Isolation capacitance	C _{iso}		.5		pF	f = 1 MHz		

	11	NDIVIDUAL CO	OMPONE	NT CHA	RACTER	RISTICS	
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
×	Forward voltage	V _F		1.20	1.50	V	I _F = 20 mA
DIODE	Forward voltage temp.					_	
	coefficient			-1.8		mV/°C	
5	Reverse breakdown voltage	BV _R	3.0	25		V	I _R = 10 μA
INPUT	Junction capacitance	C _J		50		pF	$V_F = 0 V, f = 1 MHz$
=		•		65		pΕ	$V_F = 1 V, f = 1 MHz$
	Reverse leakage current	^I R		.35	10	μΑ	V _R = 3.0 V
	DC forward current gain	hFE		170			$V_{CE} = 5 \text{ V, I}_{C} = 100 \mu\text{A}$
~	Breakdown voltage						
ő	Collector to emitter	BVCEO	80	85		V	$I_C = 1.0 \text{ mA}, I_F = 0$
ST	Collector to base	BVCBO	70	180		V	I _C = 10 μA
S	Emitter to collector	BVECO	7	11		V	$l_E = 100 \mu A, l_F = 0$
4	Leakage current						
TRANSISTOR	Collector to emitter	ICEO		5	50	nA	$V_{CE} = 10 \text{ V, I}_{F} = 0$
DUTPUT	Capacitance						
5	Collector to emitter			8		pF	$V_{CE} = 0$, f = 1 MHz
ō	Collector to base			20		pF	$V_{CB} = 5$, $f = 1 MHz$
	Emitter to base			10		рF	V _{EB} = 0, f = 1 MHz

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

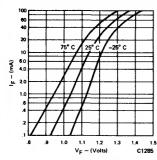
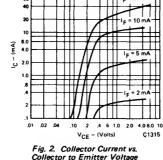


Fig. 1. Forward Voltage vs. Forward Current



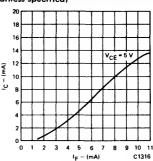


Fig. 3. Collector Current vs. Forward Current

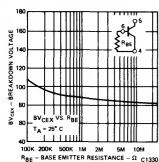


Fig. 4. Collector-Emitter Breakdown Voltage vs. Base Resistance

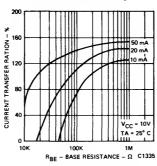


Fig. 5. Sensitivity vs. Base Resistance

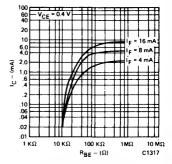


Fig. 6. Saturated CTR vs. Base to Emitter Resistance

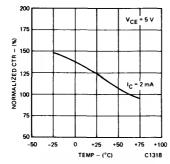


Fig. 7. Current Transfer Ratio (unsaturated) vs. Temperature

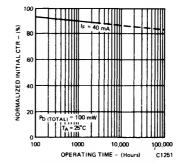


Fig. 8. Current Transfer Ratio vs. Operating Time

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE Storage temperature -55°C to 150°C Operating temperature -55°C to 100°C Lead temperature (Soldering, 10 sec) Total package power dissipation @ 25°C (LED plus detector) . . . 260 mW Derate linearly from 25°C 3.5 mW/°C

INPUT DIODE

Forward current	. 60 mA
Reverse voltage	3 V
Peak forward current	
(1 μs pulse, 300 pps)	. 3.0 A
Power dissipation 25°C ambient	90 mW
Derate linearly from 25°C 1.2	
OUTDIT TO ANGISTOD	

Power dissipation @ 25°C.				200 mW
Derate linearly from 25°C		 		2.67 mW/°C

SWITCHING CHARACTERISTICS

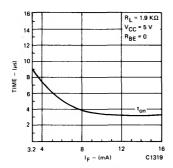


Fig. 9. Switch-on Time vs. IF Drive (saturated)

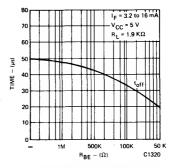


Fig. 10. Switch-off Time vs. Base to Emitter Resistance (saturated)

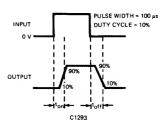


Fig. 11.

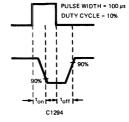


Fig. 12.

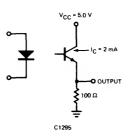


Fig. 13.

Transport to the Control of the State of the

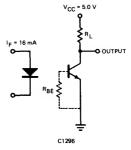


Fig. 14.

GENERAL INSTRUMENT Optoelectronics

DESIGNER SERIES

MCT276 PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

- Highest speed discrete phototransistor optoisolator
- Controlled Current Transfer Ratio 15% to 60% (specified conditions)

- Maximum Turn-on time 2.5 μseconds (specified condition)
- Maximum Turn-off time 2.5 μseconds (specified condition)
- Surge Isolation Rating 3550 volts DC 2500 volts AC, rms
- Steady-state Isolation Rating 3150 volts DC 2250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized
 File E50151

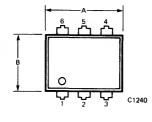
DESCRIPTION

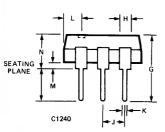
The MCT276 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with a high speed NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

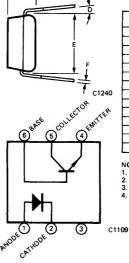
APPLICATIONS

- Data communications
- Digital ground isolation
- Digital logic inputs
- Microprocessor inputs
- Appliance sensor systems

PACKAGE DIMENSIONS







SYMBOL	INCHES MAX.	mm MAX.	NOTES
Α	.365	9.27	
В	.270	6.73	×
C	.130	3.18	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	1 .
F	.014	0.36	
G	.325	8.26	
Н	.070	1.7B	
J	.110	2.79	
К	.022	0.56	
L	.085	2.16	2
M			3
N	.175	4.45	4
			_

NOTES

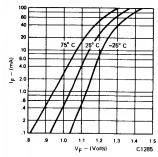
- 1. INSTALLED POSITION OF LEAD CENTERS
- 2. FOUR PLACES
 - 3. OVERALL INSTALLED POSITION
 - 4. THESE MEASUREMENTS ARE MADE FROM THE SEATING PLANE

ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

		TRANSF	ER CHA	RACTE	RISTICS		
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
DC	Current Transfer Ratio, collector to emitter (a)	ICE/IF	15	30	60	% %	I _F = 10 mA; V _{CE} = 10 V I _F = 16 mA; V _{CE} = 0.4 V
	Current Transfer Ratio,		12.5	15		%	I _E = 10 mA; V _{CB} = 10 V
	collector to base Saturation voltage	CB/IF VCE(SAT)		.15 .24	.40	v	I _F = 16 mA; I _C = 2 mA
S	Non-saturated Turn-on time	t _{on}		2.4	3.5	μς	$R_L = 100 \Omega; I_C = 2 mA;$ $V_{CC} = 5 V$
SWITCHING TIMES	Turn-off time	t _{off}		2.2	3.5	μς	See figures 11, 13
S	Saturated Turn-on time	ton		6.8		μs	I _F = 16 mA; R _L = 1.9 KΩ
12	Turn-off time (Approximates a typical 1	t _{off} FTL interface)		16		μ\$	See figures 12, 14
S	Turn-on time Turn-off time	t _{on}		5.4 32		μ s μs	$I_F = 16 \text{ mA}; R_L = 4.7 \text{ K}\Omega$ See figures 12, 14
	(Approximates a typical I		face)				
	Surge isolation	V _{iso}	3550			VDC	Relative humidity $\leq 50\%$, $I_{1-O} \leq 10 \mu\text{A}$
SOLATION	Steady state isolation	V _{iso}	2500 3150			VAC-rms VDC	t = 1 second Relative humidity ≤ 50%, I _{I-O} ≤ 10 μA
SOLA	Isolation resistance	R _{iso}	2 250 10 ¹¹			VAC-rms ohms	t = 1 minute V _{I-O} = 500 VDC
	Isolation capacitance	C _{iso}		.5		ρF	f = 1 MHz

	II.	NDIVIDUAL CO	OMPONE	NT CHA	RACTER	ISTICS	
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
۳ĺ	Forward voltage	٧ _F		1.20	1.50	V	I _F = 20 mA
DIODE	Forward voltage temp.					_	
	coefficient			-1.8		mV/°C	
TOPNI	Reverse breakdown voltage	BVR	3.0	25		V	I _R = 10 μA
Ē	Junction capacitance	C		50		рF	$V_F = 0 V, f = 1 MHz$
=				65		ρF	$V_F = 1 V, f = 1 MHz$
	Reverse leakage current	I _R		.35	10	μΑ	V _R = 3.0 V
	DC forward current gain	hFE		90			V _{CE} = 5 V, I _C = 100 μA
	Breakdown voltage						
6	Collector to emitter	BVCEO	30	45		V	I _C = 1.0 mA, I _F = 0
ST	Collector to base	BV _{CBO}	70	130		V	I _C = 10 μA
TRANSISTOR	Emitter to collector	BVECO	7	10		V	$I_E = 100 \mu A, I_F = 0$
4	Leakage current						
	Collector to emitter	ICEO		5	50	nΑ	V _{CE} = 10 V, I _F = 0
OUTPUT	Capacitance						
Ę	Collector to emitter			8		рF	V _{CE} = 0, f = 1 MHz
ŏ	Collector to base			20		ρF	V _{CB} = 5, f = 1 MHz
	Emitter to base			10		ρF	V _{EB} = 0, f = 1 MHz

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)



Walter May See

Fig. 1. Forward Voltage vs. Forward Current

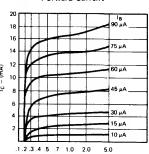


Fig. 4. Collector Current vs. Collector to Emitter Voltage

Vce - V

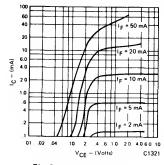


Fig. 2. Collector Current vs. Collector to Emitter Voltage

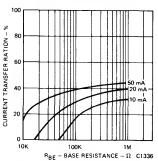


Fig. 5. Sensitivity vs. Base Resistance

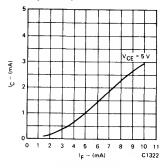


Fig. 3. Collector Current vs. Forward Current

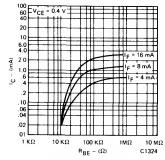
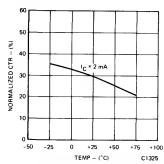


Fig. 6. Saturated CTR vs. Base to Emitter Resistance



C1323

Fig. 7. Current Transfer Ratio (unsaturated) vs. Temperature

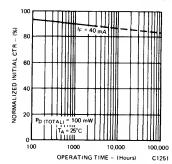


Fig. 8. Current Transfer Ratio vs. Operating Time

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

Storage temperature55°C to 150°(
Operating temperature55°C to 100°C
Lead temperature
(Soldering, 10 sec)
Total package power dissipation @ 25°C
(LED plus detector) 260 mW
Derate linearly from 25°C 3.5 mW/°C

INPUT DIODE

Forward DC current 60 mA
Reverse voltage
Peak forward current
(1 μs pulse, 300 pps) 3.0 A
Power dissipation 25°C ambient 90 mW
Derate linearly from 25°C 1.2 mW/°C
OUTPUT TRANSISTOR
_

Power dissipation @ 25°C.		200 mW
Derate linearly from 25°C	2	2.67 mW/°C

SWITCHING CHARACTERISTICS

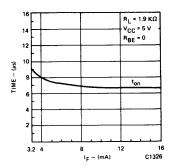


Fig. 9. Switch-on Time vs. IF Drive (saturated)

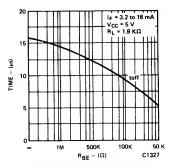


Fig. 10. Switch-off Time vs. Base to Emitter Resistance (saturated)

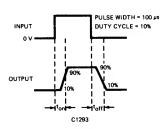


Fig. 11.

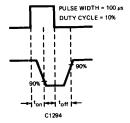


Fig. 12.

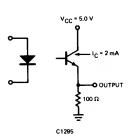


Fig. 13.

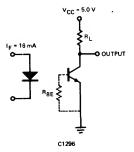


Fig. 14.

GENERAL INSTRUMENT Optoelectronics

DESIGNER SERIES

MCT277 PHOTOTRANSISTOR OPTOISOLATORS

FEATURE SPECIFICATIONS

- 40% Transfer ratio at V_{CESAT}) of 0.4 volts for multiple gate interface
- Temperature stable from 0°C to 25°C
- Maximum Turn-on time 15 μseconds (specified condition)
- Maximum Turn-off time 15 μseconds (specified condition)
- Surge Isolation Rating –
 2500 volts DC
 1500 volts AC, rms
- Steady-state Isolation Rating 1750 volts DC 1250 volts AC, rms
- Underwriters Laboratory (U.L.) recognized
 File E50151

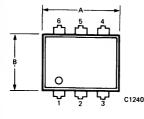
DESCRIPTION

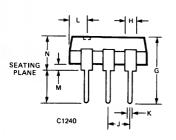
The MCT277 is a phototransistor-type optically coupled isolator. An infrared emitting diode manufactured from specially grown gallium arsenide is selectively coupled with an NPN silicon phototransistor. The device is supplied in a standard plastic six-pin dual-in-line package.

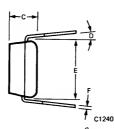
APPLICATIONS

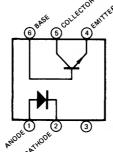
- Digital to digital system interface
- Sensor to many gates
- Ground loop isolation
- Power supply regulation

PACKAGE DIMENSIONS









SYMBOL	INCHES	mm	NOTES
31111000	MAX.	MAX.	NUTES
Α	.365	9.27	
В	.270	6.73	
C	.130	3.18	
D	15°	15°	
E	.300 Ref.	7.62 Ref.	1
F	.014	0.36	
G	.325	8.26	
Н	.070	1.78	
J	.110	2.79	
K	.022	0.56	
L	.085	2.16	2
M			3
N	.175	4.45	4
P			3

NOTES

- 1. INSTALLED POSITION OF LEAD CENTERS
- 2. FOUR PLACES
 3. OVERALL INSTALLED POSITION
- 4. THESE MEASUREMENTS ARE MADE FROM THE
 - SEATING PLANE

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ELECTRO-OPTICAL CHARACTERISTICS (25°C Temperature unless otherwise specified)

3	CHARACTERISTICS		ER CHAF	RACTER	RISTICS		
3		SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
)							
	Current Transfer Ratio, collector to emitter (a)	I _{CE} /I _F	100			%	$I_F = 10 \text{ mA}; V_{CE} = 10 \text{ V}$
	concetor to control (a)	CL	40			%	$I_F = 16 \text{ mA; } V_{CE} = 0.4 \text{ V}$
	Current Transfer Ratio,			_		0/	1 = 10 == A+V == 10 V
	collector to base	I _{CB} /I _F		.4		%	I _F = 10 mA; V _{CB} = 10 V
	Non-saturated				45		$R_L = 100 \Omega; I_C = 2 \text{mA};$
	Turn-on time	ton			15	μs	V _{CC} = 5 V
SWITCHING TIMES	Turn-off time	1.44			15	μs	See figures 15, 17
	Saturated	^t off					
	Turn-on time	ton		3.8		μs	I _F = 16 mA; R _L = 1.9 KΩ
	Turn-off time	toff		90		μs	See figures 16, 18
	(Approximates a typical TT			3.7		μs	I _F = 16 mA; R _L = 4.7 KΩ
	Turn-on time	t _{on}		190		μs	See figures 16, 18
	Turn-off time (Approximates a typical lov	t _{off} v power TTL interi	face)	100		,	
_			2500			VDC	Relative humidity ≤ 50%,
	Surge isolation	V_{isO}	2500			*50	I _{1-O} ≤ 10 μA
			1500			V AC-rms	t = 1 second
	Steady state isolation	V _{iso}	1750			VDC	Relative humidity ≤ 50%
			4050			VAC-rms	l _{I−O} ≤ 10 μA t = 1 minute
SOLATION			1250 10 ¹¹			ohms	V _{1-O} = 500 VDC
						0	- 1-0
	Isolation resistance	R _{iso}					
	Isolation capacitance	C _{iso}		1.0		pF	f = 1 MHz
	Isolation capacitance	c _{iso}	OMPONE	NT CHA		RISTICS	
	Isolation capacitance CHARACTERISTIC	C _{iso} INDIVIDUAL C SYMBOL		NT CHA	MAX.	RISTICS	TEST CONDITIONS
	Isolation capacitance CHARACTERISTIC Forward voltage	c _{iso}	OMPONE	NT CHA		RISTICS	
	CHARACTERISTIC Forward voltage Forward voltage temp.	C _{iso} INDIVIDUAL C SYMBOL	OMPONE	NT CHA	MAX.	RISTICS	TEST CONDITIONS
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient	C _{iso} INDIVIDUAL C SYMBOL V _F	OMPONE	NT CHA TYP. 1.20	MAX.	RISTICS UNITS	TEST CONDITIONS
	CHARACTERISTIC Forward voltage Forward voltage temp.	C _{iso} INDIVIDUAL C SYMBOL	OMPONE MIN.	NT CHA TYP. 1.20 -1.8 25 50	MAX.	RISTICS UNITS V mV/°C V pF	TEST CONDITIONS $I_{F} = 20 \text{ mA}$ $I_{R} = 10 \mu\text{A}$ $V_{F} = 0 \text{ V, } f = 1 \text{ MHz}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R	OMPONE MIN.	NT CHA TYP. 1.20 -1.8 25 50 65	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF	TEST CONDITIONS $I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{ V}, \text{ f} = 1 \text{ MHz}$ $V_F = 1 \text{ V}, \text{ f} = 1 \text{ MHz}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R	OMPONE MIN.	NT CHA TYP. 1.20 -1.8 25 50 65 .35	MAX.	RISTICS UNITS V mV/°C V pF	TEST CONDITIONS I _F = 20 mA I _R = 10 µA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz V _R = 3.0 V
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J	OMPONE MIN.	NT CHA TYP. 1.20 -1.8 25 50 65	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF	TEST CONDITIONS $I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{ V}, \text{ f} = 1 \text{ MHz}$ $V_F = 1 \text{ V}, \text{ f} = 1 \text{ MHz}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE}	OMPONE MIN. 3.0	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF pF µA	TEST CONDITIONS $I_F = 20 \text{ mA}$ $I_R = 10 \mu\text{A}$ $V_F = 0 \text{ V, f} = 1 \text{ MHz}$ $V_F = 1 \text{ V, f} = 1 \text{ MHz}$ $V_R = 3.0 \text{ V}$ $V_{CE} = 5 \text{ V, I}_C = 100 \mu\text{A}$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE} BVCEO	OMPONE MIN.	NT CHA TYP. 1.20 -1.8 25 50 65 .35	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF	TEST CONDITIONS I _F = 20 mA I _R = 10 µA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz V _R = 3.0 V V _{CE} = 5 V, I _C = 100 µA I _C = 1.0 mA, I _F = 0 I _C = 10 µA
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE}	OMPONE MIN. 3.0	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF µA	TEST CONDITIONS $I_{F} = 20 \text{ mA}$ $I_{R} = 10 \mu \text{A}$ $V_{F} = 0 \text{ V, f} = 1 \text{ MHz}$ $V_{F} = 1 \text{ V, f} = 1 \text{ MHz}$ $V_{R} = 3.0 \text{ V}$ $V_{CE} = 5 \text{ V, I}_{C} = 100 \mu \text{A}$ $I_{C} = 1.0 \text{ mA, I}_{F} = 0$
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE} BVCEO BVCEO BVCEO	30 70	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420 45 130	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF μA	TEST CONDITIONS I _F = 20 mA I _R = 10 μA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz V _R = 3.0 V V _{CE} = 5 V, I _C = 100 μA I _C = 1.0 mA, I _F = 0 I _C = 100 μA, I _F = 0
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE} BVCEO BVCEO BVCEO	30 70	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420 45 130	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF pF µA	TEST CONDITIONS I _F = 20 mA I _R = 10 µA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz V _R = 3.0 V V _{CE} = 5 V, I _C = 100 µA I _C = 1.0 mA, I _F = 0 I _C = 10 µA
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE} BVCEO BVCEO BVECO BVECO	30 70	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420 45 130	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF μA	TEST CONDITIONS I _F = 20 mA I _R = 10 μA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz V _R = 3.0 V V _{CE} = 5 V, I _C = 100 μA I _C = 1.0 mA, I _F = 0 I _C = 100 μA, I _F = 0
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter Collector to emitter	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE} BVCEO BVCEO BVECO BVECO	30 70	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420 45 130	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF μA	TEST CONDITIONS I _F = 20 mA I _R = 10 µA V _F = 0 V, f = 1 MHz V _F = 1 V, f = 1 MHz V _R = 3.0 V VCE = 5 V, I _C = 100 µA I _C = 1.0 mA, I _F = 0 I _C = 100 µA, I _F = 0 VCE = 10 V, I _F = 0 VCE = 10 V, I _F = 1
	CHARACTERISTIC Forward voltage Forward voltage temp. coefficient Reverse breakdown voltage Junction capacitance Reverse leakage current DC forward current gain Breakdown voltage Collector to emitter Collector to base Emitter to collector Leakage current Collector to emitter	C _{iso} INDIVIDUAL C SYMBOL V _F BV _R C _J I _R h _{FE} BVCEO BVCEO BVECO BVECO	30 70	NT CHA TYP. 1.20 -1.8 25 50 65 .35 420 45 130 10 5	MAX. 1.50	RISTICS UNITS V mV/°C V pF pF pF pF v v v	TEST CONDITIONS $I_{F} = 20 \text{ mA}$ $I_{R} = 10 \mu\text{A}$ $V_{F} = 0 \text{V}, f = 1 \text{MHz}$ $V_{F} = 1 \text{V}, f = 1 \text{MHz}$ $V_{R} = 3.0 \text{V}$ $V_{CE} = 5 \text{V}, I_{C} = 100 \mu\text{A}$ $I_{C} = 1.0 \text{mA}, I_{F} = 0$ $I_{C} = 100 \mu\text{A}, I_{F} = 0$ $V_{CE} = 10 \text{V}, I_{F} = 0$

	II.	IDIVIDUAL CO	OMPONE	NT CHA	RACTER	RISTICS	
	CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
w l	Forward voltage	V _F		1.20	1.50	V	I _F = 20 mA
DIODE	Forward voltage temp.	•		4.0		mV/°C	
	coefficient			-1.8		mv/ C	I _R = 10 μA
INPUT	Reverse breakdown voltage	BVR	3.0	25		-	
١ چ	Junction capacitance	CJ		50		pF	$V_F = 0 V, f = 1 MHz$
=	1			65		рF	$V_F = 1 V, f = 1 MHz$
	Reverse leakage current	¹R		.35	10	μΑ	V _R = 3.0 V
	DC forward current gain	hFÉ		420			$V_{CE} = 5 \text{ V, I}_{C} = 100 \mu\text{A}$
	Breakdown voltage						
۳.	Collector to emitter	BVCEO	30	45		V	$I_C = 1.0 \text{ mA}, I_F = 0$
Ĕ	Collector to base	BVCBO	70	130		V	I _C = 10 μA
Si	Emitter to collector	BVECO	7	10		V	$I_E = 100 \mu A, I_F = 0$
Š	Leakage current	200					
TRANSISTOR	Collector to emitter	ICEO		5	50	nA	V _{CE} = 10 V, I _F = 0
	2555.5. 15 0(45	CLO					
OUTPUT	Capacitance					_	
5	Collector to emitter			8		pF	$V_{CE} = 0$, $f = 1 MHz$
ಠ	Collector to base			20		pF	$V_{CB} = 5$, $f = 1 MHz$
	Emitter to base			10		рF	$V_{EB} = 0$, $f = 1 MHz$

ABSOLUTE MAXIMUM RATINGS

TOTAL PACKAGE

IUIAL PACKAGE	
Storage temperature	55°C to 150°C
Operating temperature	
Lead temperature	
(Soldering, 10 sec)	260° C
Total package power dissipation @ 2	25°C
(LED plus detector)	260 mW
	2 5 mW/°C

INPUT DIODE

Forward DC current							60 mA
Reverse voltage							3 V
Peak forward current							
(1 μs pulse, 300 pps)							3.0 A
Power dissipation 25°C.	٠.						90 mW
Derate linearly from 25°C					0.	8	mW/°C
OUTPUT TRANSISTOR							

Power dissipation @ 25°C. . 200 mW Derate linearly from 25°C 2.67 mW/°C

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

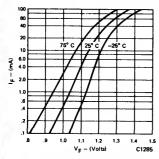


Fig. 1. Forward Voltage vs. Forward Current

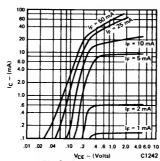


Fig. 2. Collector Current vs. Collector to Emitter Voltage

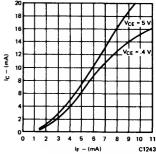


Fig. 3. Collector Current vs. Forward Current

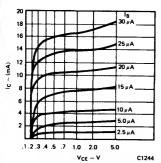


Fig. 4. Collector Current vs. Collector to Emitter Voltage

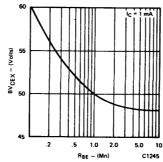


Fig. 5. Collector to Emitter Breakdown Voltage vs. Base to Emitter Resistence

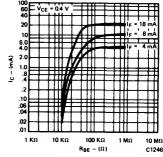


Fig. 6. Saturated CTR vs. Bese to Emitter Resistence

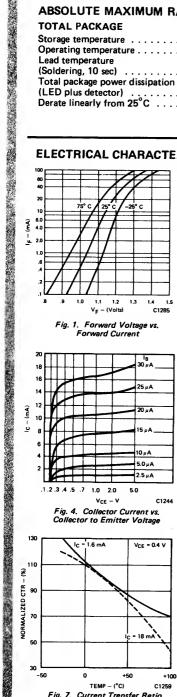


Fig. 7. Current Trensfer Retio (saturated) vs. Temperature

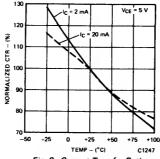


Fig. 8. Current Trensfer Ratio (unsatureted) vs. Temperature

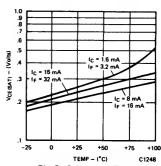


Fig. 9. Collector to Emitter Saturation Voltage vs. Temperature

ELECTRICAL CHARACTERISTIC CURVES (25°C Free air temperature unless specified)

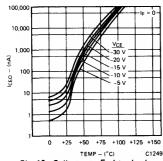


Fig. 10. Collector to Emitter Leakage Current vs. Temperature

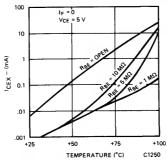


Fig. 11. Collector to Emitter Leakage Current vs. Temperature

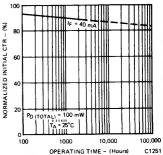


Fig. 12. Current Transfer Ratio vs. Operating Time

SWITCHING CHARACTERISTICS

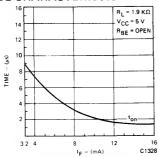


Fig. 13. Switch-on Time vs. IF Drive (saturated)

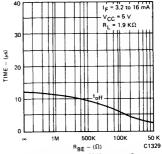


Fig. 14. Switch-off Time vs. Base to Emitter Resistance (saturated)

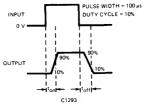


Fig. 15.

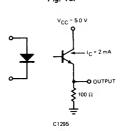
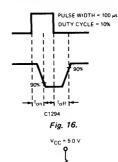


Fig. 17.



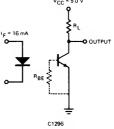


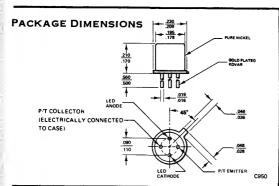
Fig. 18.

GENERAL INSTRUMENT Optoelectronics

MCT4 PHOTOTRANSISTOR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCT4 is a standard four-lead, TO-18 package containing a GaAs light emitting diode optically coupled to an NPN silicon planar phototransistor.



FEATURES

- Hermetic package
- High current transfer ratio; typically 35%
- High isolation resistance; 10¹¹ ohms at 500 volts
- High voltage isolation emitter to detector

ABSOLUTE MAXIMUM RATINGS

Storage temperature — -65°C to 150°C Operating temperature — -55°C to 125°C Lead soldering time @ 260°C - 10.0 seconds

LED(GaAs Diode)
Power dissipation @ 25°C ambient 90 mW
Derate linearly from 25°C 1.2 mW/°C
Continuous forward current 40 mA
Reverse voltage
Peak forward current 3.0 A
(1 μs pulse, 300 pps)
Total power dissipation 250 mW
Derate linearly from 25°C 3.3 mW/°C

DETECTOR (Silicon phototransistor)
Power dissipation @ 25°C ambient 200 mW
Derate linearly from 25°C 2.67 mW/°C
Collector-emitter breakdown voltage
(BV _{CEO}) 30 volts
Emitter-collector breakdown voltage.
(BV _{ECO}) 7.0 volts
ISOLATION VOLTAGE 1000 VDC

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free Air Temperature Unless Otherwise Specified)

	•				iso opecimea)		
CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS		
Emitter							
Forward voltage		1.3	1.5	V	I _E =40 mA		
Reverse current		.15	10	μΑ	V _R =3.0 ∨		
Capacitance		150		pF	V=0		
Detector				•			
BV _{CEO}	30			V	I _C =1.0 mA, I _F =0		
BVECO	7	12		V	$I_E = 100 \mu A, I_E = 0$		
I _{CEO} (Dark)		5	50	nΑ	V _{CF} =10 V, I _F =0		
Capacitance collector-emitter		2		pF	V _{CF} =0		
Coupled					02		
DC current transfer ratio	15	35		%	I _F =10 mA, V _{CF} =10 V		
Breakdown voltage	1000	1500		VDC	t = 1 second		
Resistance emitter-detector	1011	1012		ohms	V = 500 VDC		
V _{CE(SAT)}		0.1		V	$I_{C} = 500 \mu A$, $I_{E} = 10 \text{ mA}$		
		0.2	0.5	V	I _C =2 mA, I _E =50 mA		
Capacitance LED to detector		1.8		рF			
Bandwidth (see figure 5)		300		kHz	Note 2		
Rise time and fall time		2		μs	I _C =2 mA, V _{CF} =10 V		
(see operating schematic)					Note 3		

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES

(25°C Free Air Temperature Unless Otherwise Specified)

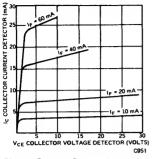


Figure 1 Detector Output Characteristics

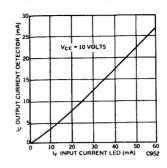


Figure 2 Input Current vs. Output Current

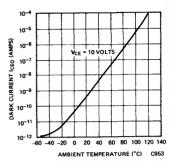


Figure 3 Dark Current vs. Temperature (°C)

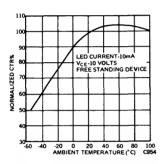


Figure 4 Current Output vs. Temperature

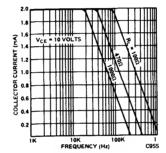


Figure 5 Output vs. Frequency

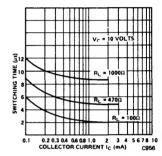
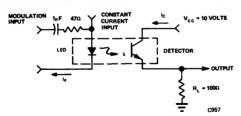


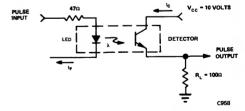
Figure 6 Switching Time vs. Collector Current

For additional characteristic curves, see MCT2

OPERATING SCHEMATICS



Modulation Circuit Used to Obtain Output vs. Frequency Plot



Circuit Used to Obtain Switching Time vs. Collector Current Plot

NOTES

- The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.
- 2. The frequency at which ic is 3 dB down from the 1 kHz value.
- Rise time (t_f) is the time required for the collector current to increase from 10% of its final value, to 90%. Fall
 time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

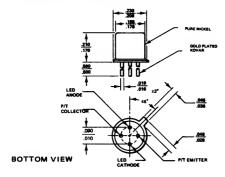
GENERAL INSTRUMENT Optoelectronics

MCT4-R RELIABILITY CONDITIONED PHOTOTRANSISTOR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCT4 is a standard four-lead, TO-18 package containing a GaAs light emitting diode optically coupled to a silicon planar phototransistor.

PACKAGE DIMENSIONS



FEATURES

- Hermetic package
- High current transfer ratio; typically 35%
- High isolation resistance: 10¹¹ ohms at 500 volts
- High voltage isolation emitter to detector

The Monsanto MCT 4R is designed and manufactured to conform to the requirements of military systems. Reliability testing has proven the product capable of conforming to the screening and quality conformance requirements of MIL-STD-883 Class B devices.

SCREEN - 100%

Characteristic	Method
Internal Visual	2010 — Characteristics applicable to device
Stabilization Bake	1008 – 150°C. for 48 hours
Temperature Cycle	1010 - 10 cycles; -55°C., 25°C., 150°., 25°C.
Centrifuge	2001 - Test Condition E
Hermeticity	1014 — Fine and Gross
Critical Electrical	 Data Sheet
Burn In*	1015 – 168 hours @ 125°C.
Final Electrical	 Data Sheet
Group A Sample Inspection	5005 Table I Subgroups
External Visual	2009

LOT QUALIFICATION TESTS

Characteristic	Method	LTPD
Subgroup I		
Visual Mechanical		
Marking Permanency	2008	15%
Physical Dimensions		
Titysical Difficusions		
Subgroup II	0000	15%
Solderability	2003	13/0
Subgroup III	0 0	
Thermal Shock	1011 -15 cycles; 150°C. to -65°C.	
Temperature Cycle	1010 -10 cycles; -55°C., 25°C., 150°C., 25°C.	15%
Moisture Resistance	1004	
Critical Electrical	Data Sheet	
Subgroup IV		
Mechanical Shock	2002 — Condition B	15%
Vibration Fatigue	2005 - Condition A	
Vibration Variable Frequency	2007 - Condition A	
Constant Acceleration	2001 - Condition E	
Critical Electrical	Data Sheets	
Officer Electrical		
Subgroup V	OOOA O wilding B	15%
Lead Fatigue	2004 — Condition B ₂	157
Hermeticity	1014 – Fine Condition A	
	Gross Condition C	
Subgroup VI		
Salt Atmosphere	1009 - Condition A	159
LI	FE TESTING 7% LTPD	
Subgroup VII		
High Temperature Storage	1008 - 150°C. for 1000 hours	7%
Critical Electrical	Data Sheet	
Subgroup VIII		
Operating Life	1005 - Condition B	7%
Critical Electrical	 Data Sheets 	
Sittled Electrical		
Subgroup IX		70
Steady State Reverse Bias	1015 – Condition A; 72 hours at 150° C.	7%
Subgroup X		
Bond Strength:	2001 —Condition C; 10 devices only	

Reference: MIL-STD-883, Test Methods and Procedures for Microelectronics.

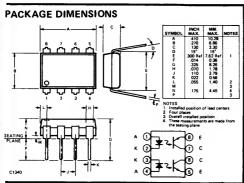
GENERAL INSTRUMENT Optoelectronics

MCT6 DUAL PHOTOTRANSISTOR OPTOISOLATOR

STATE OF THE STATE

PRODUCT DESCRIPTION

The MCT 6 opto-isolator has two channels for high density applications. For four channel applications, two-packages fit into a standard 16-pin DIP socket. Each channel is an NPN silicon planar phototransistor optically coupled to a gallium arsenide diode.



FEATURES

- Two isolated channels per package
- Two packages fit into a 16 lead DIP socket
- Same basic electrical characteristics as MCT2
- 1500 volt isolation
- 50% typical current transfer ratio

APPLICATIONS

- AC Line/Digital Logic Isolate high voltage transients
- Digital Logic/Digital Logic Eliminate spurious grounds
- Digital Logic/AC Triac Control . . . Isolate high voltage transients
- Twisted pair line receiver Eliminate ground loop feedthrough
- Telephone/Telegraph line receiver. . Isolate high voltage transients
- High Frequency Power Supply
- right riequency rower supply
 - Feedback Control. Maintain floating ground
- Relay contact monitor Isolate floating grounds and transients
- Power Supply Monitor Isolate transients

ABSOLUTE MAXIMUM RATINGS

Storage Temperature -55°C to 150°C Operating Temperature -55°C to 100°C Lead Temperature (soldering, 10 sec.) 250°C

INPUT DIODE (each channel)		•
Forward current	 	. 60 m/
Reverse voltage		
Peak forward current (1 µs pulse, 300 pps)	 	3
TOTAL INPUT		
Power dissipation at 25°C ambient	 	100 mV
Derate linearly from 25°C		

OUTPUT TRANSISTOR (each channel)

COUPLED

Input to output breakdown voltage 1500 volts DC

Total package power dissipation @ 25°C ambient . . . 400 mW

Derate linearly from 25°C 5.33 mW/°C

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Rated forward voltage V _F		1.25	1.50	V	I _F = 20 mA
Reverse voltage V _R	3.0	25		V	Ι _Β = 10 μΑ
Reverse current I R		.01	10	μΑ	V _B = 3.0 V
Junction capacitance C _J		50		pF	V _F = 0 V
OUTPUT TRANSISTOR (IF = 0)					
Breakdown voltage, collector to emitter BVCFO	30	85		V	I _C = 1.0 mA
Breakdown voltage, emitter to collector BV _{ECO}	6	13		V	I _E = 100 μA
Leakage current, collector to emitter ICEO		5	100	nA	V _{CF} = 10 V
Capacitance collector to emitter C _{CE}		8		pF	V _{CE} = 0 V
COUPLED					
DC current transfer ratio (I _C /I _F) CTR	20	50		%	V _{CF} = 10 V, I _F = 10 mA
Isolation voltage BV _(I-O)	1500	2500		VDC	t = 1 second
Isolation resistance R _(IU)	10 ¹¹	10 ¹²		Ω	V _{I-O} = 500 VDC
Isolation capacitance C _(1-O)		0.5		pF	f = 1 MHz
Breakdown voltage - channel-to-channel		500		·v	Relative humidity = 40%
Capacitance between channels		0.4		pF	f = 1 MHz
Saturation voltage collector to emitter V _{CE(SA}	Τ\	.20	.40	v	I _C = 2 mA, I _F = 16 mA
Bandwidth B _W	''	150		kHz	I _C = 2 mA, V _{CC} = 10 V, R ₁ =

ELECTRO-OPTICAL CHARACTERISTICS (Con't)

CHARACTERISTICS	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES, OUTPUT TRANSISTOR Non-saturated rise time, fall time		2.4		μ s	$I_C = 2 \text{ mA}, V_{CE} = 10 \text{ V}, R_L = 100\Omega$
Non-saturated rise time, fall time		15		μs	$I_C = 2 \text{ mA}, V_{CE} = 10 \text{ V}, R_L = 1 \text{ K}\Omega$
Saturated turn-on time (from 5.0 V to 0.8 V)		5		μs	$R_L = 2 K\Omega$, $I_F = 15 mA$
Saturated turn-off time (from saturation to 2.0 V)		25		μs	$R_L = 2 K\Omega$, $I_F = 15 mA$

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (25°C Free Air Temperature Unless Otherwise Specified)

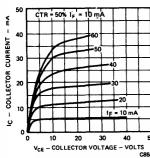


Figure 1 I-V Curve of Phototransistor

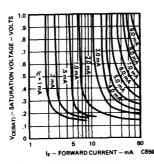


Figure 2 I-V Curve in Saturation

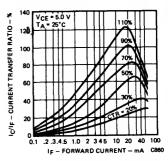


Figure 3 CTR vs. Forward Current

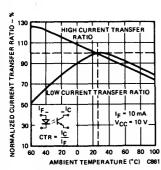


Figure 4 Current Transfer Ratio vs. Temperature

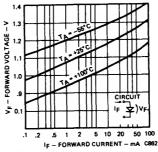


Figure 5 I-V Curve of LED vs. Temperature

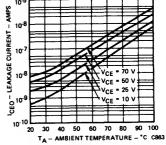


Figure 6 Leakage Current vs. Temperature vs. Collector Voltage

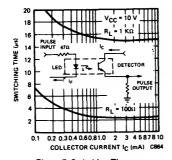


Figure 7 Switching Time vs. Collector Current

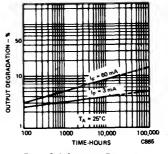


Figure 8 Lifetime vs. Forward Current (Note 1)

NOTES

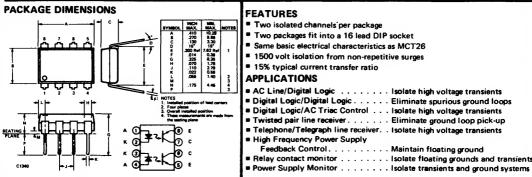
1. Normalized CTR degradation = $\frac{\text{CTR}_{o} - \text{CTR}_{o}}{\text{CTR}_{o}}$

GENERAL INSTRUMENT Optoelectronics

MCT66 DUAL PHOTOTRANSISTOR OPTOISOLATOR

PRODUCT DESCRIPTION

The MCT 66 opto-isolator has two channels for high density applications. For four channel applications, two-packages fit into a standard 16-pin DIP socket. Each channel is an NPN silicon planar phototransistor optically coupled to a gallium arsenide diode.



FEATURES

- Two isolated channels per package
- Two packages fit into a 16 lead DIP socket
- Same basic electrical characteristics as MCT26
- 1500 volt isolation from non-repetitive surges
- 15% typical current transfer ratio

APPLICATIONS

- AC Line/Digital Logic Isolate high voltage transients ■ Digital Logic/Digital Logic Eliminate spurious ground loops ■ Digital Logic/AC Triac Control . . . Isolate high voltage transients Twisted pair line receiver Eliminate ground loop pick-up ■ Telephone/Telegraph line receiver. . Isolate high voltage transients ■ High Frequency Power Supply Feedback Control Maintain floating ground ■ Relay contact monitor Isolate floating grounds and transients
- **ABSOLUTE MAXIMUM RATINGS**

Storage Temperature -55°C to 150°C Operating Temperature -55°C to 100°C Lead Temperature (soldering, 10 sec.) 250°C

INPUT DIODE (each channel)		
Forward current,		. 60 mA
Reverse voltage		. 3.0 V
Peak forward current (1 µs pulse, 300 pps) .		3A
Power dissipation at 25°C ambient		 100 mW
Derate linearly from 25°C		

OUTPUT TRANSISTOR (each channel) Power dissipation @ 25°C ambient 150 mW Derate linearly from 25°C 2 mW/°C COUPLED Input to output breakdown voltage 1500 volts DC Total package power dissipation @ 25°C ambient . . 400 mW Derate linearly from 25°C 5.33 mW/°C

ELECTRO-OPTICAL CHARACTERISTICS (25°C Free	Air Temp	erature U	nless Otherw	rise Specified)
CHARACTERISTICS	MIN.	TÝP.	MAX.	UNITS	TEST CONDITIONS
INPUT DIODE					
Rated forward voltage V _F		1.25	1.50	V	I _E = 20 mA
Reverse voltage V _R	3.0	25	_	V	$I_{\rm D} = 10 \mu \text{A}$
Reverse current I R	_	.001	10	μΑ	$\vec{V}_{R} = 3.0 \text{ V}$
Junction capacitance C _J	_	50	_	pF	V _F = 0 V
OUTPUT TRANSISTOR (I = 0)					
Breakdown voltage,					
collector to emitter BV _{CEO}	30	85	_	V	I _C = 1.0 mA
Breakdown voltage,					Č
emitter to collector BV _{ECO}	6	13	_	V	$I_E = 100 \mu\text{A}$
Leakage current, collector to emitter I CEO	-	5	100	nΑ	V _{CE} = 10 V
Capacitance collector to emitter C _{CE}		8		pF	V _{CE} = 0 V
COUPLED					
DC current transfer ratio (I _C /I _F) = CTR	6	15	_	%	V _{CE} = 10 V, I _F = 10 mA
Isolation voltage BV _(I-O)	1500	2500	-	VDC	t = 1 second
Isolation resistance R _(LO)	1011	10 ¹²	-	Ω	V _{I-O} = 500 VDC
Isolation capacitance C _(I-O)	-	0.5	-	pF	f = 1 MHz
Breakdown voltage — channel-to-channel	_	500	-	VDC	Relative humidity = 40%
Capacitance between channels	-	0.4	-	pF	f = 1 MHz
Saturation voltage —					
collector to emitter V _{CE} (SAT)	-	0.2	0.4	V	I _C = 2 mA, I _F = 40 mA
Bandwidth B _W	-	150	_	kHz	$I_C = 2 \text{ mA}, V_{CC} = 10 \text{ V}, R_L = 100 \Omega$

ELECTRO-OPTICAL CHARACTERISTICS (Con't)

	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
SWITCHING TIMES, OUTPUT TRANSISTOR Non-saturated rise time, fall time (Note 3)		2.4		μs	$I_C = 2 \text{ mA}, V_{CE} = 10 \text{ V}, R_L = 100 \Omega$
Non-saturated rise time, fall time (Note 3)		15		μs	$I_C = 2 \text{ mA}, V_{CF} = 10 \text{ V}, R_L = 1 \text{ k}\Omega$
Saturated turn-on time (from 5.0 V to 0.8 V)		5		μs	$R_1 = 2 K\Omega$, $I_F = 40 mA$
Saturated turn-off time (from saturation to 2.0 V)		25		μs	$R_L = 2 K\Omega$, $I_F = 40 mA$

TYPICAL ELECTRO-OPTICAL CHARACTERISTIC CURVES (25°C Free Air Temperature Unless Otherwise Specified)

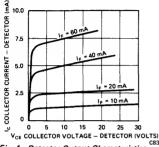


Fig. 1. Detector Output Characteristics

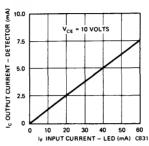
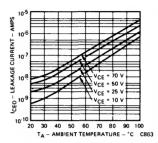


Fig. 2. Input Current vs. Output Current



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Fig. 3. Leakage Current vs. Temperature vs. Collector Voltage

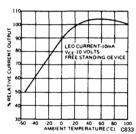


Fig. 4. Current Output vs. Temperature

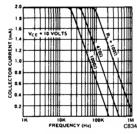


Fig. 5. Output vs. Frequency

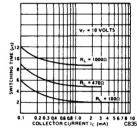


Fig. 6. Switching Time vs. Collector Current

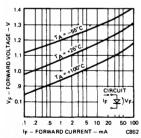


Fig. 7. I-V Curve of LED vs. Temperature

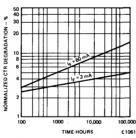
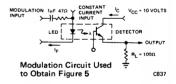
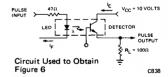


Fig. 8. Lifetime vs. Forward Current





NOTES

- 1. The current transfer ratio (I_C/I_F) is the ratio of the detector collector current to the LED input current with V_{CE} at 10 volts.
- 2. The frequency at which ic is 3 dB down from the 1 kHz value.
- Rise time (t_f) is the time required for the collector current to increase from 10% of its final value to 90%.
 Fall time (t_f) is the time required for the collector current to decrease from 90% of its initial value to 10%.

GENERAL INSTRUMENT Optoelectronics

MID400 OPTICALLY ISOLATED INTERFACE DEVICE

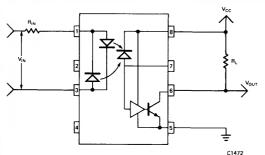


Fig. 1. MID400 Interfacing Circuit

FEATURES

- Direct operation from 120 VAC line with the use of an external resistor
- Externally adjustable time delay
- Externally adjustable AC voltage sensing level
- High voltage isolation between input and output
- Compact plastic DIP package
- Logic level compatibility
- UL recognized (File #E50151)

ACKAGE MATERIAL5 Leads — Tinned with 60/40 tin lead Body — Silicone plastic

SYMBOL	INCH MAX.	MM, MAX.	NOTE5	PIN	VIN
A	410	10.29		2	N/C
8	270	6.86		3	
C	_130	3.30		3	VIN
D	15	15		4	N/C
E	300 Ref	7 62 Ref	1	5	GROUND
F	-014	0 36		6	Vo
G	325	8.26			
H	070	1 78		7	AUX
J	110	2 79		8	Vcc
K	022	0 56			
L	.055	1.40	2		
M			2 3		
N	175	4.45	4		
P			3		

- NOTES
 1. Installed position of lead centers
 2. Four places
 3. Overall installed position
 4. These measurements are made froi

2250 V RMS

APPLICATIONS

- Monitoring of the AC "line-down" condition
- "Closed-loop" interface between electromechanical elements such as solenoids, relay contacts, small motors, and microprocessors
- Time delay isolation switch

DESCRIPTION

The MID400 is an optically isolated AC line-to-logic interface device. It is packaged in an 8-lead plastic DIP. The AC line voltage is monitored by two back-to-back GaAs LED diodes in series with an external resistor. A high gain detector circuit senses the LED current and drives the output gate to a logic low condition.

The MID400 has been designed primarily for use as an AC line monitor. It is recommended for use in any ACto-DC control application where excellent optical isolation, solid state reliability, TTL compatibility, small size, low power, and low frequency operation are required.

ABSOLUTE MAXIMUM RATINGS

ELECTRICAL CHARACTERISTICS

(0°C to 70°C Free Air Temperature Unless Otherwise Specified – All Typical Values Are At 25°C) Device Operation Input Voltage Range: 24 VAC to 240 VAC.

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	TEST CONDITIONS
LED Forward Voltage	V _F			1.5	V	$I_F = \pm 30 \text{ mA DC}$
On-state RMS Input Voltage	V _{I(ON)} RMS	90			V	V_O = 0.4 V, l_O = 16 mA V_{CC} = 4.5 V, R_{IN} = 22 K Ω
Off-state RMS Input Voltage	V _{I(OFF)} RMS			5.5	٧	V_O = V_{CC} = 5.5 V, $I_O \le 100 \mu A$, R_{IN} = 22 K Ω
On-state RMS Input Current	I _{I(ON)} RMS	4.0			mA	V_{O} = 0.4 V, I_{O} = 16 mA V_{CC} = 4.5 V 24 V \leq V _{I(ON)} RMS \leq 240 V
Off-state RMS Input Current	I _{I(OFF)} RMS			.15	mA	$\label{eq:Vo} \begin{split} &V_{O} = V_{CC} = 5.5 \text{ V, I}_{O} \leq 100 \mu\text{A,} \\ &V_{I(OFF)} \text{ RMS} \geq 5.5 \text{ V} \end{split}$
Logic Low Output Voltage	V _{OL}		.18	0.40	V	$\begin{array}{l} \rm{I_{IN}} = \rm{I_{I(ON)}} \; RMS \\ \rm{I_O} = 16 \; mA, V_{CC} = 4.5 \; V \\ \rm{24} \; V \leq V_{I(ON)} \; RMS \leq 240 \; V \end{array}$
Logic High Output Current	Гон		.02	100	μΑ	I_{IN} = 0.15 mA RMS V_O = V_{CC} = 5.5 V $V_{I(OFF)}$ RMS \geq 5.5 V
Logic Low Output Supply Current	Iccı			3.0	mA	$I_{\rm IN}$ = 4.0 mA RMS $V_{\rm O}$ = Open, $V_{\rm CC}$ = 5.5 V 24 V \leq V _{I(ON)} RMS \leq 240 V
Logic High Output Supply Current	I _{CCH}			0.80	mA	I _{IN} = 0.15 mA RMS V _{CC} = 5.5 V V _{I(OFF)} RMS ≥ 5.5 V
SWITCHING TIMES (TA = +2	5°C)					
Turn-On Time	^t on		1.0		mS	I_{IN} = 4.0 mA RMS I_O = 16 mA, V_{CC} = 4.5 V R_{IN} = 22 K Ω (See Test Circuit 2)
Turn-Off Time	t _{OFF}		1.0		mS	I_{IN} 4.0 mA RMS I_O = 16 mA, V_{CC} = 4.5 V R_{IN} = 22 K Ω (See Test Circuit 2)
ISOLATION (T _A = +25°C)						
Surge Isolation Voltage	V _{ISO}	3550			VDC	Relative Humidity ≤ 50%, I _{I-O} ≤ 10µA
		2500			VACRMS	1 Second, 60 Hz
Steady State Isolation Voltage	V _{ISO}	3200			VDC	Relative Humidity ≤ 50%,
		2250			VACRMS	I _{I-O} ≤ 10μΑ 1 Minute, 60 Hz
Isolation Resistance	R _{ISO}	1011			Ω	V _{I-O} = 500 VDC
Isolation Capacitance	C _{ISO}		2		pF	f = IMHZ
(RMS = True RMS Voltage at 60 H	z, THD ≤ 1%.)					

DESCRIPTION/APPLICATIONS

The input of the MID400 consists of two back-to-back LED diodes which will accept and convert alternating currents into light energy. An integrated photo diode-detector amplifier forms the output network. Optical coupling between input and output provides 3550 V DC voltage isolation. A very high current transfer ratio, (defined as the ratio of the DC output current and the DC input current) is achieved through the use of a high gain amplifier. The detector amplifier circuitry operates from a 5 V DC supply and drives an open collector transistor output. The switching times are intentionally designed to be slow in order to enable the MID400, when used as an AC line monitor, to respond only to changes of input voltage exceeding several milliseconds. The short period of time during zero crossing which occurs once every half cycle of the power line is completely ignored. To operate the MID400, always add a resistor, R_{IN}, in series with the input (as shown in Fig. 1) to limit the current to the required value. The value of the resistor can be determined by the following equation:

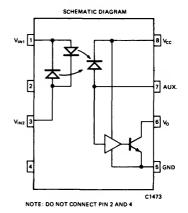
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$$R_{IN} = \frac{V_{IN} - V_F}{I_{IN}}$$

Where V_{IN} (RMS) is the input voltage. V_F is the forward voltage drop across the LED. I_{IN} (RMS) is the desired input current required to sustain a logic "O" on the output.

PIN DESCRIPTION

DESIGNATION	PIN #	FUNCTION
V_{IN1}, V_{IN2}	1, 3	Input terminals.
V _{cc}	8	Supply voltage, output circuit.
AUX.	7	Auxiliary terminal. Program- mable capacitor input to adjust AC voltage sensing level and time delay.
Vo	6	Output terminal; open collector.
GND	5	Circuit ground potential.



4. 人名西班牙斯 医含数100mm

GLOSSARY

VOLTAGES

VI(ON) RMS On-state RMS input voltage

The RMS voltage at an input terminal for a specified input current with output conditions applied that according to the product specification will cause the output switching element

to be sustained in the on-state within one full cycle.

VI(OFF) RMS Off-state RMS input voltage

The RMS voltage at an input terminal for a specified input current with output conditions applied that according to the product specification will cause the output switching element

to be sustained in the off-state within one fill cycle.

VOL Low-level output voltage

The voltage at an output terminal for a specific output current I_{OL} with input conditions

applied that according to the product specification will establish a low-level at the output.

VOH High-level output voltage

The voltage at an output terminal for a specified output current IOH with input conditions

applied that according to the product specification will establish a high-level at the output.

V_F LED forward voltage

The voltage developed across the LED when input current IF is applied to the anode of the

LED.

CURRENTS

I I (ON) RMS On-state RMS input current

The RMS current flowing into an input with output conditions applied that according to the

product specification will cause the output switching element to be sustained in the on-state

within one full cycle.

I (OFF) RMS Off-state RMS input current

The RMS current flowing into an input with output conditions applied that according to the

product specification will cause the output switching element to be sustained in the off-state

within one full cycle.

IOH High-level output current

The current flowing into * an output with input conditions applied that according to the

product specification will establish a high-level at the output.

I_{OL} Low-level output current

The current flowing into * an output with input conditions applied that according to the

product specification will establish a low-level at the output.

I_{CCL} Supply current, output low

The current flowing into * the V_{CC} supply terminal of a circuit when the output is at a

low-level voltage.

ICCH Supply current, output high

The current flowing into * the V_{CC} supply terminal of a circuit when the output is at a

high-level voltage.

DYNAMIC CHARACTERISTICS

ton Turn-on time

The time between the specified reference points on the input and the output voltage wave-

forms with the output changing from the defined high-level to the defined low-level.

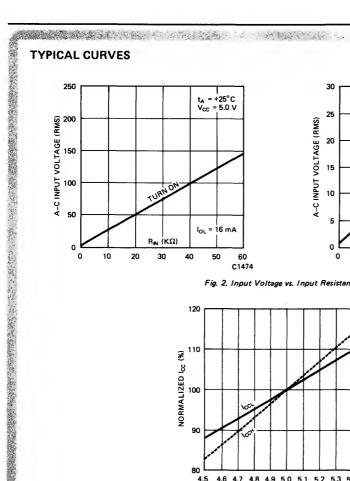
toff Turn-off time

A CANADA SANCE OF THE SANCE OF

The time between the specified reference points on the input and output voltage waveforms

with the output changing from the defined low-level to the defined high-level.

^{*}Current flowing out of a terminal is a negative value.



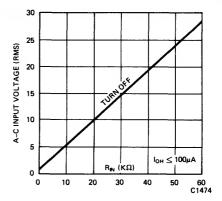


Fig. 2. Input Voltage vs. Input Resistance

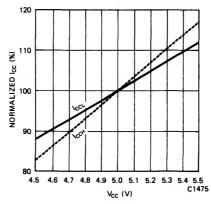


Fig. 3. Supply Current vs. Supply Voltage

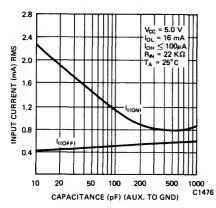


Fig. 4. Input Current vs. Capacitance (See test circuit 1)

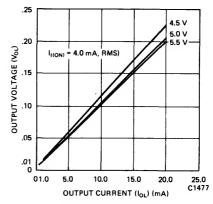
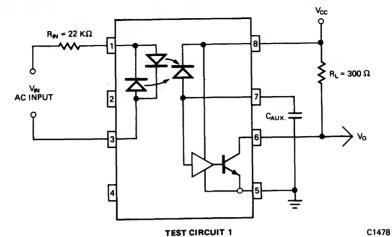
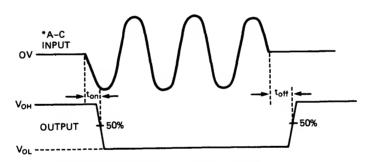


Fig. 5. Output Voltage vs. Output Current

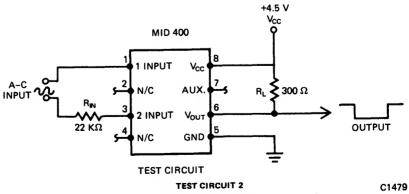
OPERATING SCHEMATICS



Input Current vs. Capacitance, CAUX, Circuit



*INPUT TURNS ON AND OFF AT ZERO CROSSING.



MID400 Switching Time

Technical Information

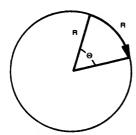
the photometry of LED's a primer in photometry

REVIEW OF GEOMETRIC PRINCIPLES

Any short discourse on the subject of photometry requires a brief review of geometric principles utilized.

RADIAN

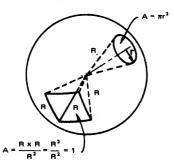
In plane geometry the angle whose arc is equal to the radius generating it is called a radian. Therefore, if $C=2\pi R$ (Circumference of a circle) $2\pi R=360^\circ$. Radian = $180^\circ/\pi=57.27^\circ$ (approx.)



TWO DIMENSIONAL FIGURE
FIGURE 1

STERADIAN

In solid geometry one steradian is the solid angle subtended at the center of a sphere by a portion of the surface area equal to the square of the radius of the sphere. Therefore, if $AREA/R^2=1=1$ steradian and the area on the surface of a sphere equals $4\pi R^2$, then $4\pi R^2/R^2$ or 4π steradians of solid angle ω about the center of a sphere. The steradian is usually abbreviated as STER.



THREE DIMENSIONAL FIGURE
FIGURE 2

Other abbreviations of immediate concern are:

Ae = Area of emitting (or reflecting) surface.

Ap = Apparent area of an emitting source whose image is protected in space and viewed at some angle, Θ.

Ad = Detection area. Whether a physical target or merely a defined spatial area, it is the area of interest.

PHOTOMETRIC TERMINOLOGY

FLUX (Symbol F)

Any radiation, whether visible or otherwise, can be expressed by a number of FLUX LINES about the source, the number being proportional to the intensity of that source. This LUMINOUS flux is expressed in LUMENS for visible radiation.

LUMINOUS EMITTANCE (Symbol L)

A source measurement parameter. It is defined as the ratio of the luminous flux emitted from a source to the area of that source, or L = F/Ae. Typically expressed in units of:

lumens/cm² or one PHOT,

lumens/m2 or one LUX (or one METER CANDLE),

lumens/ft2 or one FOOT CANDLE.

The foot candle is the more common term used in this country.

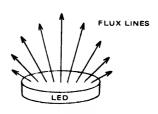
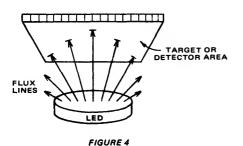


FIGURE 3

ILLUMINANCE (Symbol E)

This is a target or detector area measurement parameter. It is the ratio of flux lines incident on a surface to the area of that surface or E = L/Ad. Typical measurement units are the same for LUMINOUS EMITTANCE (above) i.e. lumen/cm² = one phot, lumen/m² = one lux, and lumen/ft² = one ft. candle.



LUMINOUS INTENSITY (Symbol I)

A spatial flux density concept. It is the ratio of luminous flux of a source to the solid angle subtended by the detected area and that source. The LUMINOUS IN-TENSITY of a source assumes that source to be point rather than an area dimension. The LUMINOUS INTENSITY (or CANDLE POWER) of a source is measured in LUMENS/STERADIAN which is equal to one CANDELA (or loosely, one CANDLE).

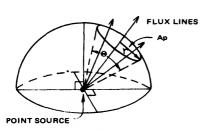


FIGURE 5

LUMINANCE (Symbol B)

Sometimes called photometric brightness (although the term brightness should not be used alone as it encompasses other physiological factors such as color, sparkle, texture, etc.) it is applied to sources of appreciable area size. Mathematically, if the area of an emitter (circular for example) has a diameter or diagonal dimension greater than

0.1 the distance to the detector, it can be considered as an area source. If less than this 10% figure, the source can be treated as point in nature. This one to ten ratio of source diameter to distance is offered as it MATHEMATICALLY very closely approximates results obtained when comparing an area source to its point equivalent. LUMINANCE presents itself as an extremely useful parameter as it applies a figure of merit to:

- 1. Apparent or protected area of the source (Ap).
- 2. Amount of luminous flux contained within the proiected area of the source (Ap).
- 3. Solid angle the projected area generates with respect to the center of the source.

NOTE: The projected area Ap varies directly as the cosine of Θ i.e. max. at 0° or normal to the surface and minimum at 90°

$$Ap = Ae \cos \Theta$$

LUMINANCE is defined as the ratio of LUMINOUS IN-TENSITY to the projected area of the source Ap.

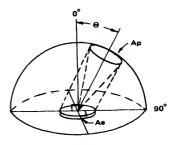


FIGURE 6

LUMENS STERADIAN _ CANDELAS **LUMINOUS INTENSITY** (Sq. Unit) Ae cos Θ Aρ

And depending on the units used for area:

- 1 CANDELA/cm2 = 1 STILB
- 1 CANDELA/m² = 1 NIT
- 1 CANDELA/in² =) 1 CANDELA/ft² =) no designator available.

Also:

 $1/\pi$ candela/cm² = LAMBERT

 $1/\pi$ candela/m² = APOSTILB (or BLONDEL)

= no designator available 1/π candela/in²

1/π candela/ft² = FOOT LAMBERT

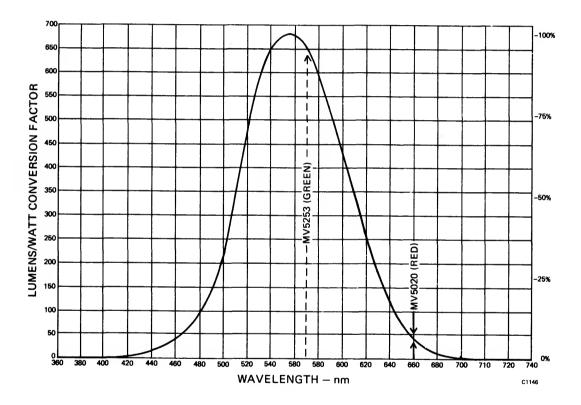
CIE CURVE

Following is the standard observer curve or "standard eyeball" established by the Commission Internationale de l'Eclair (commonly called the CIE curve). Whereas one watt of radiated energy at any frequency corresponds to one watt of radiated energy at any other frequency, this relationship fails to hold true for photometric measurement. The CIE curve is essential therefore, not only in determining the eye's efficiency at any particular wavelength, but also the corresponding lumens per watt conversion of that particular wavelength.

For example, the MV5020 which emits 180 μ W of radiant energy at 6600Å (typical) or 41.4 lumens per watt has

$$180 \times 10^{-6} \text{ watts } \times \frac{41.4 \text{ lumens}}{\text{watt}} = 7.45 \text{ mLumens}$$

of flux emitted from it.



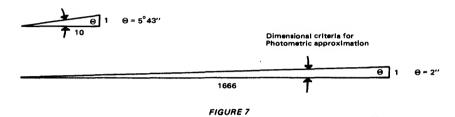
Similarly, a green emitter such as the MV5253 operating at an identical input power as the red will emit 10 μ watts of radiant energy or

$$10 \times 10^{-6}$$
 watts $\times \frac{649 \text{ lumens}}{\text{watt}} = 6.49 \text{ mLumens}$

of flux emitted from it. In short although there exists at least an order of magnitude difference in radiant power the eyes' compensating effect "magnifies" the green to appear equally bright.

LUMINOUS INTENSITY versus LUMINANCE

The successful application of either measurement parameter as a yardstick to duplicate mathematically the visual stimulation experienced by an observer is a controversy which will probably rage for some time. As the entire electromagnetic spectrum is bounded only by the capabilities of a detector to discern it, so for within the visual spectrum the eye is the limiting factor. SUBJECTIVELY speaking, the eye can discern finer increments of arc (computed from target to eye) than a 1 to 10 relationship, or approximately 5° 43 min. In fact, it can be shown that for view angles of much less than 2 minutes, the eye translates the source into a point and thus the photometric measurement of LUMINOUS INTENSITY (in candelas) most directly correlates with subjective brightness. For view angles of much greater than approximately 2 minutes, the eye sees the source as an area source, and thus the photometric measurement of LUMINANCE most directly correlates with subjective brightness. A two minute view angle computes to a 1/1666 ratio of source diameter to distance ratio. For the MV5025 this computes to approximately 22 feet (1666 x .16" diameter, approximately 22 feet) well within the expected normal viewing distance of an observer.



Considering that the usage of the discrete MV5025 LED is as an indicator and as such is utilized arms length or approximately 30" away, it can be seen that the LUMINANCE parameter and its basic unit, the FOOT LAMBERT, most closely correlates with subjective brightness.

Below are the products, their respective chip dimension, either diameter or diagonal, apparent size due to optical magnification and luminance/luminous intensity crossover distance. It should be stressed that this distance is not finite but represents a gradual threshold distance at which either parameter might be definitive.

Product	Active Chip Area	Optical Lens Factor	Apparent Size	Crossover Distance Feet
MV10B	.015"	x1.9	.028"	3.96
MV50	.017" diag.	x1.75	.030''	3.0
MV5020	.017" diag.	x1.5	.025′′	2.5
MV5025	(.160")*	(x15.2)	.160"	22.2

^{*}Entire lens is considered the apparent emitting area.

RADIOMETRY

While photometric units are concerned with only the visible spectrum of wavelength, all frequencies of emission, including the visible are expressable in RADIOMETRIC terms. Radiometric terms and their photometric equivalents are as follows:

RADIOMETRIC

Radiant flux (Symbol P) expressed in watts Irradiance (Symbol H) expressed in watts/sq. unit Radiant Emittance (Symbol W) expressed in watts/sq. unit Radiant Intensity (Symbol J) expressed in watts/steradian Radiance (Symbol N) expressed in watts/ster/sq. unit

PHOTOMETRIC

Luminous flux (F) expressed in lumens flluminance (E) expressed in lumens/sq. unit Luminous Emittance (L) expressed in lumens/sq. unit Luminous Intensity (Symbol I) expressed in lumens/steradian Luminance (B) expressed in lumens/ster/sq. unit

AN603 improper testing methods for LED devices

In any manufacturing operation it is essential that the materials used in the fabrication process meet the minimum quality specifications of the device under production. To that end, prudent manufacturers establish some sort of incoming quality assurance system to make sure that defective materials are culled at the door. It is equally important, however, that the screening system used in the Q.A. inspection does not reject materials which are acceptable, and that the testing procedures utilized in the system do not inadvertently damage materials which are otherwise acceptable. Unfortunately, this latter aspect of quality assurance procedures is often neglected, and whenever a device is rejected because of inappropriate testing methods, both the manufacturer and the vendor are subject to a great deal of unnecessary expense and inconvenience. Because many manufacturers who buy LED components are relatively inexperienced with the features and limitations of III-V devices, problems involving improper testing methods and unnecessary materials rejection are of particular concern to LED vendors. This note is intended to familiarize the user with the basic electrical and opto-electrical properties of LED devices and to clear up some of the problems involved in testing them.

THE MATERIAL

Historically, silicon and germanium were the first semiconductor materials to have been used for p-n junction devices such as transistors, diodes, and solar cells. However, following closely upon the invention of the germanium transistor in 1948, work was begun on predicting the semiconductivity of a material from its chemical compound. Based on energy band-gap experimentation, it was discovered that III-V materials have semiconductor properties.¹

Gallium semiconducting materials, Gallium Arsenide (GaAs), Gallium Arsenide Phosphide (GaAsP), and Gallium Phosphide (GaP) are the materials from which LED's are fabricated. These materials have the ability to emit a narrow band of monochromatic light in either the visible or infrared spectrum, depending on the constituent and ratio of ingredients. The mechanism for this emission of radiant energy is best described in terms of

¹E.G. Bylander, *Materials for Semiconductor Functions* (New York, 1971), p. 17.

semiconductor Energy-Band Theory. When an external, forward-biasing voltage is applied to a p-n junction, the conduction mechanism is such that electrons are excited by the electric field, gaining enough energy to cross the energy gap from the valence band to the conduction band, and then to relax back from the conduction band into the valence band. During the transition from the valence band to the conduction band, the electrons take energy from the field. As they pass back into the valence band, the electrons release this energy in the form of light photons. The amount of energy released is determined by the width of the energy gap. (The wavelength, or color, or the light is a function of the energy gap.) The light is emitted directly from the electrons within the depletion region formed between the two sides of the junction.

The electrical characteristics of LED's are also related to the energy gap. For example, the conduction threshold, or "knee" point on the I_f/V_f curve in the forward-biased direction occurs at approximately 1.0 volts for infrared LED's, at approximately 1.3 volts for visible red LED's, and from 1.8 to 2 volts for yellow and green LED's. The brightness of the light is directly proportional to the operating current flowing in the forward direction.

GALLIUM VS. SILICON

As a semiconductor, III-V compounds using Gallium have several advantages over silicon and germanium—reverse leakage current is several orders of magnitude lower; forward current is lower below the "knee" point; inherent thermal noise is lower; and carrier mobility is high. Perhaps the greatest advantage, certainly where LED's are concerned, is the ability to produce light directly from electron flow.

Figure 1 shows a comparison between the forward conduction characteristics of diodes formed from III-V materials and silicon. Notice that the "knee" of the conduction curve for the Gallium diodes occurs at higher voltages, and is harder than the "knee" of silicon diodes. Notice also that as the wavelength progresses from the infrared toward the blue end of the spectrum, the GaAsP "knee" points get progressively higher and the slope of the $I_{\rm f}/V_{\rm f}$ curve tends to decrease. Excluding exotic devices such as Schottky or Esaki diodes, silicon diode de-

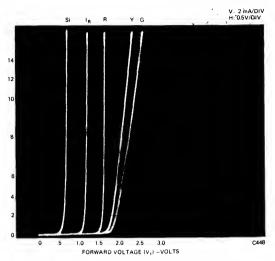


Fig. 1. Typical I_f/V_f Curves of Silicon, GaAs, and GaAsP, GaP (Silicon-IN914, IR-ME7024, Red-MV5053, Yellow-MV5353, Green-MV5253)

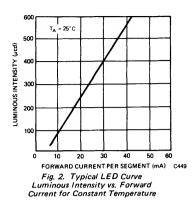
vices normally show little difference in the forward conduction curve.

The reverse characteristics of III-V materials are similar to those of silicon except that silicon's thermal leakage current is higher at very low reverse voltages. The reverse breakdown voltages of silicon are typically higher, and the characteristics of silicon devices are usually controlled for reverse breakdown at particular voltages. The reverse breakdown characteristics of diodes used in LED devices are not particularly controlled, since the quality of light emission is the first priority. The MANX and MANXX series displays use LED's which have a typical reverse-mode breakdown voltage range of from 5 to 20 volts. However for guard-band purposes, the reverse voltage is specified on the data sheets at 5 volts minimum.

If a silicon device is subject to junction damage, it will often continue to perform adequately because of silicon's inherent annealing capability. When damage occurs to the junction of an LED device, however, the result is usually a softening of the "knee" or a flattening of the I_f/V_f curve. Although the device may continue to operate, performance will be less than satisfactory, and early failure may result.

DAMAGE MECHANISMS

The discussion which follows will treat, in some detail, the most common errors in LED test set-ups and will



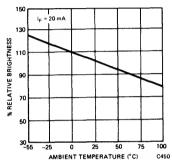


Fig. 3. Typical LED Curve Brightness vs. Temperature for Constant Current

suggest either alternative testing methods or means by which improper testing methods can be corrected to produce more reliably accurate results.

Testing for Fabrication Defects

Thermal Shock-is a passive mode test involving a rapid refrigerate/heat cycle in which no current is applied to the device. This test is a good method for detecting weak bonds and, therefore, locating defective devices, but it should be used cautiously, especially with LED's. In LED's a 1-mil gold wire is bonded from the top of the die over to the side contact, whether it is lead frame or substrate. The wire is surrounded by the epoxy which encloses the die and forms the package. When heat is applied, the epoxy, the gold, and the lead frame all expand at different rates. Thus, when the device is heated up too rapidly, the effects on the bond are similar to giving the wire a hard jerk. This action constitutes thermal shock and tends to weaken even good bonding and, consequently, shorten life expectancy.

Burn-In—consists of operating the device at elevated temperatures, thus accelerating the effects of operationally imposed heating. This method is frequently used in testing semiconductors, but its use is not advised with LED's, especially if the testing involves operating with excess current or current which exceeds the device ratings for several hours. LED's exhibit a gradual degradation of brightness as a function of current, time, and

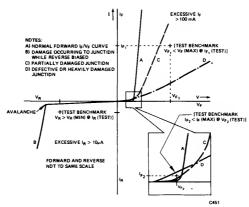


Fig. 4. Effects of Improper Testing Procedure

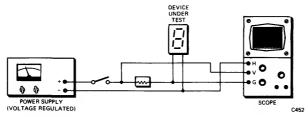


Fig. 5. Potentially Damaging Forward-Mode Test Setup

temperature, and the higher the current, the faster the degradation. The graphs in Figures 2 and 3 illustrate typical LED responses to forward current and temperature. Exceeding the rated parameters in test can result in rapid degradation beyond an acceptable level. For the same reasons, burn-in is particularly inadvisable with LED's if the test set-up involves slow on-off cycles of overcurrent (cyclic room temperature to high temperature and then cooling).

Thermal Cycling—is an on-off cycling method which simulates operational heating effects. The device is allowed to heat up from room temperature with rated current, and is then cooled down. Thermal cycling is an excellent method for finding defective devices (poor bonds, fractures in the metalization, voids in the dieattach, etc.), and its use is recommended for testing LED's. Too often, such thermal cycling occurs in actual use, and defects are detected too late. However, to insure against exceeding the rated capabilities of a particular device, a thermal cycling test program (or operational program) should not be established without factory guidance.

Reverse Conduction Mode Problems

Reverse voltage testing can be hazardous since it may involve a system capable of delivering voltages and currents which considerably exceed the reverse voltage and power ratings of the device under test. Too much current at the avalanche voltage will dissipate excessive

power, resulting in heat which will degrade the junction rapidly. The importance of adequate current limiting cannot be over-emphasized. Without it, damage to the junction can result from testing into the avalanche region and/or from the sudden application of voltage which exceeds the rated avalanche breakdown voltage of the device. Damage in the avalanche region is usually the result of an improperly set testing apparatus. As Figure 4 indicates, damage may not be immediately apparent, but it could result in poor performance during other test situations and possible rejection of the device due to excessive voltage or current values.

Forward Conduction Mode Problems

Forward mode testing is used to check such performance criteria as the forward V/I curve of the diode, brightness. ROP, and luminescence. The potential danger in examining the forward curve is damage to the diode junction, since the test circuitry can sometimes deliver very high energy bursts. For example, if a 50-volt regulated power supply is set for 5 volts to supply the test fixture, and if power is supplied through a switch as shown in Figure 5. it is possible to deliver current pulses of a high enough amplitude to result in junction damage. This problem is easily avoided by supplying low voltage power with current limiting to the test fixture. Another acceptable method, and the one which is used by General Instrument quality assurance engineers, is to use a power supply which is both full voltage regulated and current limited.

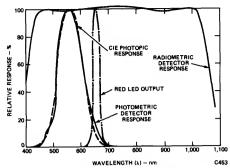


Fig. 6. Responses of Two Detectors to the Output of a Visible Red LED

Brightness Tests

Optical measurements are typically, and in most instances, unavoidably, of very low accuracy. Optical measurements with errors of less than 1% are rare, and accuracy within 5% is difficult to obtain. With an experienced technician using good equipment it is possible to secure accuracy within 10% to 20% on a routine basis, but even here a slight difference in technique can result in errors in excess of 50%.

Detectors-A good detector approximates the CIE curve area with 2%. However, it is important to note that even when the detector is within 2% of perfect, it is still possible to produce mismatches at specific wavelengths which can cause the percentage of error to increase considerably. Therefore, in order to determine the margin of possible error, it is imperative that one know the detector's spectral response within the wavelength range of the device to be measured. To illustrate the problem of spectral mismatch, the reader is referred to Figure 6 where we show the responses of two detectors, a radiometric detector and a photometric detector, to the output of a visible red LED. The response of the radiometric detector is about 3% high. Notice, however, that the photometric detector, which provides a very close match to the CIE curve, produces a +25% error.2

Additional factors which must be considered are detector aging and filter deterioration, nonlinear detector responses, circuitry which is not temperature-compensated, and stray light. Periodic calibration is essential if a reasonable degree of accuracy is to be maintained.

Correlation Samples—Unless the testing apparatus is reciprocally related to a vendor-supplied correlation sample, test results may erroneously indicate that many devices in a shipment do not meet the minimum brightness that was specified on the order, and could result in the rejection of devices which do meet minimum stan-

dards. Correlation samples are also essential for the correction of instrumentation drift.

Subjectivity Problems—In some instances a visual comparison may be the best method for brightness testing. However, the manner by which the human eye "sees" is affected by various factors such as the nature of the light source, viewing distance, color, texture, the observer's visual acuity, and even the viewer's emotional state. Therefore, because of these highly subjective factors involved in human visual perception, such tests alone are usually inadequate and should be used only as a supplement to or in correlation with instrumentation. It has been our experience that manufacturers who rely solely on visual testing return many devices, a fair percentage of which can be reshipped and accepted.

Testing to Parameters Other Than Those Specified—This is a particularly important consideration when a manufacturer specifies his own parameters distinct from those normally specified. To avoid unnecessary rejection of devices, it is imperative that a device is always tested to the parameters under which it will be expected to operate.

SUGGESTIONS FOR PROPER TESTING

That which follows is a quick check list of "do's" which enable manufacturers to avoid many of the problems associated with running incoming quality assurance tests on LED's.

- In cooperation with the vendor, establish specifications which are economically feasible and ensure that devices are screened at their point of origin.
- Always obtain a correlation sample from the vendor before setting up the test procedure.
- Establish a reliable test procedure.
- Measure relevant parameters at relevant points.
- Make sure that the test circuitry will not erroneously indicate defects and that it will not generate failures later in the manufacturing cycle.
- Work closely with the vendor in establishing the test system.

²Michael A. Zaha, "Shedding Some Needed Light on Optical Measurements," *Electronics*, November 6, 1972, pp. 94-96.

AN301 discrete LED selecting made easier

Light Emitting Diodes, LED's, have come into widespread use on the electronics scene. This application note is intended to aid the designer in selecting a particular device from the many LED's offered today. The more important parameters as well as some littleknown pitfalls are discussed.

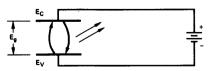
THEORY

Although light emission from a semiconductor junction had long been speculated, the first commercial devices did not become available until about 1963. This light emission phenomenon can be explained in terms of Semiconductor Energy-Band Theory. An external voltage applied to forward-bias a PN junction excites the majority carriers (electrons), causing them to move from the N-side Conduction Band to the P-side Valence Band. In making this transition the electrons cross the Energy Gap, Eg, that separates the two Bands, and so have to give up energy in the form of heat (phonons) and light (photons).

Each semiconductor material type has an E_g characteristic, and the wavelength (λ) of emitted light depends upon the magnitude of E_g , (see Figure 1). For example, Gallium Arsenide material, GaAs, has an $E_g=1.35~{\rm eV}$ and a $\lambda_{peak}=9000~{\rm Å}$. The wavelength (i.e., color) emitted by some other materials made from Gallium compounds are listed in Table 1.

Material	Wavelength	Color
GaAs:Zn	9000A	infrared
GaAsP_4	6600A	red
GaAsP _{.5}	6100A	amber
GaAsP 85:N	5900A	yellow
GaP:N	5600A	green

Table 1. Some Wavelentghs and Colors Emitted by Gallium Compounds



Wavelength of Emission (λ_{peak}) $\cong \frac{12380}{E_g}$ (in Angstrom units)

(Equation 1)

Fig. 1. Relationship Between Band-Gap Energy and Wavelength

ELECTRICAL CONSIDERATIONS

Most incandescents are rated in terms of voltage; LED's, on the other hand, are current-dependent devices since they are basically diodes. When operating from constant-voltage sources, protection should be provided by incorporating a current-limiting resistor with each LED.

Basic DC Circuit. For the simple circuit shown in Figure 2 the resistor value can be calculated from

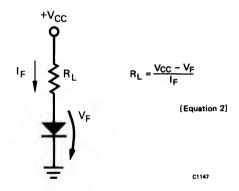


Figure 2.

where V_F and I_F are taken from an LED Data Sheet. The power rating required for the resistor should also be kept in mind.

Design Example #1: Suppose that a MV50 is to be used with Figure 2's circuit and a $V_{\rm CC}$ of +5 volts. Figure 3a shows the MV50's Brightness versus $I_{\rm F}$ curve, and Figure 3b shows $I_{\rm F}$ volte that Brightness varies directly with $I_{\rm F}$). Further suppose that a Brightness of 800 foot-Lamberts is decided upon. From Figure 3a we see that $I_{\rm F}$ must be set at 13 mA, from Figure 3b we see that $V_{\rm F}$ will be 1.5 volts when $I_{\rm F}$ is 13 mA. Substituting these values in Equation 2, we obtain

$$R_L = \frac{V_{CC} - V_F}{I_F}$$
, $R_L = \frac{5 - 1.5}{0.013}$, $R_L = 269$ ohm.

From the expression, Power = $(I_F)^2 R_L$, we see that R_L 's power rating can be 1/8 watt.

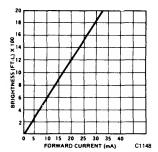


Figure 3a.

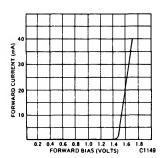


Figure 3b.

Active-Low Drive Circuit. Figure 4 shows a single-transistor drive circuit that lights the LED when the transistor is "low," i.e., conducting. The value for R_{L} can be calculated from

$$R_L = \frac{V_{CC} - V_F - V_{CE(sat)}}{I_F}$$

[Equation 3]

Active-High Drive Circuit. Figure 5 shows a single-transistor drive circuit that lights the LED when the transistor is "high," i.e., not conducting. Equation 2 can be used for calculating the value of $R_{\rm L}$. The transistor should have a $V_{\rm CE}$ of approximately 0.4 volts when conducting.

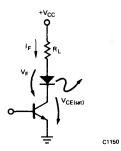
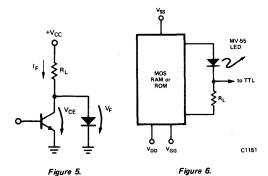


Figure 4.

Figure 6 shows a circuit that has an MOS IC output driving both an LED and a TTL logic input.

Design Example #2: Suppose that a given MOS ROM, operated with V_{SS} = +12 volts, V_{GG} = -12 volts, and V_{DD} = ground, is to drive an LED and a TTL logic input. Further suppose that the LED's brightness is to be adequate for use as a trouble-shooting indicator lamp.

From the data sheet for a MV55 we see that this low-cost, low-current LED typically delivers a usable 125 foot-Lamberts when $I_{\rm F}$ is 1 mA, and has an $I_{\rm F}$ maximum rating of 3 mA. A value of 6.8 Kohm should be used for $R_{\rm L}$.



AC Operation. LED's should be operated in the forward direction only. Therefore, the LED circuit must provide reverse-voltage protection if applied voltage is expected to exceed the V_R maximum rating of the LED. Figure 7a shows a circuit having an ordinary silicon diode (e.g., 1N914) placed "back-to-back" with the LED. Figure 7b shows an alternate and more novel approach that utilizes two LED's in parallel. If no current flows, neither LED lights. But as long as current does flow (in either direction), one of the LED's lights and one does not (because one LED will be conducting

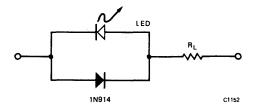


Fig. 7a. Bipolar Operation

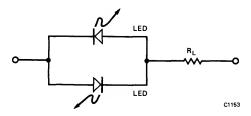


Fig. 7b. Bipolar Operation

and the other not conducting.) An extension of this back-to-back thinking led to the development of the bipolar devices, i.e., the MV5094 (Red/Red) and the MV5491 (Red/Green). These are actually two diodes in each package allowing either AC/DC or tri-state status indication.

If reverse operation (below breakdown) is expected for any length of time, then the designer should be aware of the fact that reverse leakage over temperature of LED materials (GaAs, GaAsP, etc.) is significantly less than that of silicon diode materials.

Pulsed Operation. Significantly higher peak LED light output can be obtained from ampere-level drive current pulses (of narrow width and at low duty cycle) than from steady-state driving. For example, total radiated power (expressed in milliwatts) from a ME7021, infrared-emitting LED, operated steady-state (typically with $I_{\rm F}=100$ mA) is 2 mW. But this output increases to 50 mW when driven by a 6 amp, one microsecond-wide pulse at 0.1% Duty Cycle. It should be pointed out that this factor of 25 increase comes at the expense of a somewhat lower internal (quantum) efficiency.

Besides the increase in average power just described, pulsed operation of visible-emitting LED's also gives rise to a human perception phenomenon commonly known as Light Enhancement. This phenomenon is due in part to the eye's retention of high brightness levels (such as those produced by camera flash bulbs). A numerical Light Enhancement Factor (always greater than 1) can be defined by the following ratio:

Light Enhancement Factor =

I_{DC} (steady-state operation) to produce Brightness "B"

laverage (pulsed operation) to produce Brightness "B"

[Equation 6]

This Light Enhancement phenomenon is available only from GaAsP because this LED material will not saturate under high-current conditions.

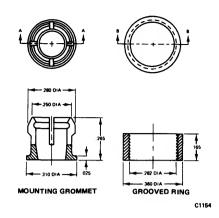
When the human eye is the detector of visible energy, lower average power is consumed by pulsed operation than by steady-state operation. This advantage of pulsed operation is especially important for battery-powered applications and for applications in which large LED arrays are being driven.

MOUNTING CONSIDERATIONS

Panel Mounting. In the "Pop-In" panel mounting method, (see Figure 8a), a black plastic mounting grommet is placed over the top of the lens and the LED is inserted—leads first—into the panel mounting hole until the grommet's flange butts against the panel. Next a grooved ring is placed against the inside-panel end of the grommet, and the ring is pushed on until the LED is securely held in place. The grommet's black color provides contrast improvement. This mounting method allows mounting of the MV5020-Series (T1% size)lamps in % in. diameter holes on panels having thicknesses from 0.62 in, to 0.125 in.

A method for mounting LED types without using mounting hardware is to drill the panel holes and either epoxy the LED's into place or solder them to a back-panel printed circuit board, (see Figure 8b).

Printed Circuit Board Mounting. The most common techniques for mounting LED's on P.C. Boards are illustrated in Figure 9. The lead bending can be per-



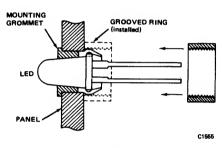
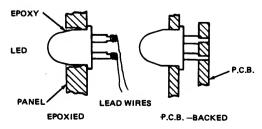


Figure 8a.

formed by the user, or arrangements can be made to have it done prior to shipment from the Factory.

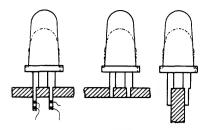
OPTICAL CONSIDERATIONS

Lens Effects. Lenses of the earliest LED's were designed to pass maximum light in the forward direction, i.e., perpendicular to the mounting surface, (see Figure 10). Later LED's produced more light and their lenses were designed to spread light over a wider area, thus permitting broader observer viewing angles. Still later, as higher light output LED's became available, a variety of red-colored, epoxy lenses came into use. These lenses act to diffuse light into a broader apparent emitting area. LED lenses that produce a broad, evenly-diffused light

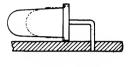


C1156

Fig. 8b. LED's Mounted Without Hardware



(a) LED's mounted without leads being bent



(b) LED mounted with leads bent

C1157

Fig. 9. Techniques for Mounting LED's on P.C. Boards

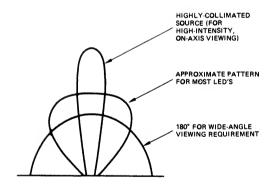


Fig. 10. Different Lens Effects (Used on the Same LED)

are generally assumed to be more pleasing to the eye than lenses that produce a highly-intense point of light. Figure 11 illustrates the effects of adding varying amounts of red diffusants to the epoxy lens material.



(a) Clear Lans (b) Partially Diffused (c) Fully Flooded (Point Source) (Area Source)

Fig. 11. Epoxy Lenses With Varying Amounts of Diffusants

Light Measurement. The manner by which the human eye "sees" is highly subjective and is affected by various factors such as "nature" of the light source (i.e., "point" or "area" source), viewing distance, color, and the observer's visual acuity. For example, it has been found that a "standard" observer with 20/20 vision can discern objects having dimensions that transcribe angles as small as two minutes. To such an observer a source having a 0.16-inch diameter and positioned farther away than 22 feet seems more "point" than "area" in nature.

Two photometric parameters which designers find useful for evaluating LED light output are Luminous Intensity, I, and Luminance (Brightness), B, (see Table 2). While an infinitely-small light source exists in theory only, the following expression can provide a means for determining the distance at which the eye loses its ability to discern an "area" and begins to see a "point."

THRESHOLD DISTANCE = $\frac{\text{Diameter of Light Source}}{\text{TAN 0}^{\circ} 2'}$ (At which sources "lose" their area) [Equation 7]

From this determination the designer can decide whether to use the I or B parameter for his evaluation of LED light output. The "diameter of the light source" in Equation 7 is the apparent emitting area of the LED. For a "clear" lens LED, (Figure 11a), multiply diode emitting area by the lens magnifying factor. (Unless stated otherwise, most clear lenses magnify by about 2X.) For a "flooded" lens LED, (Figure 11c), use the outside package diameter. For a partially-diffused lens LED, (Figure 11b), a good rule of thumb is one-half the outside package diameter.

Nature of Source	Photometric Parameter	Symbol	Units	Measurement of
Point	Luminous Intensity	ı	candela	Luminous Flux/steradian
Area	Luminance (Brightness)		Lambert	Luminous Flux/steradian (π)(Area of source in ft ²) Luminous Flux/steradian Area of source in cm ²

Table 2. I and B Photometric Parameters

Contrast Ratio. The degree by which an observer distinguishes an object or source is a function both of time spent looking and of Contrast Ratio. Contrast Ratio is defined as "the difference in Luminance between an object and its background." or

CONTRAST RATIO =
$$\frac{L_s - L_b}{L_b}$$

where "L_s" is a Source Luminance and "L_b" is Background Luminance

[Equation 8]

After an observer has focused on an object for longer than about one second, the time factor becomes negligible and Contrast Ratio remains as the important factor.

Human Factors Studies have shown that a Contrast Ratio of 10 is the minimum design value. Knowing this, and knowing the background Luminance of some common materials under normal illumination levels, we can easily determine the minimum acceptable Luminance levels required from our LED light sources.

Design Example #3: Suppose that the illumination level produced by normal laboratory lighting is approximately 25 foot-candles, and that the reflection from a light-gray panel under this lighting produces a Background Luminance, L_b, of approximatley 10 foot-Lamberts. What is the minimum acceptable Luminance which must be produced by an LED mounted on this panel?

Substituting the above values into Equation 8, we have

$$10 = \frac{L_s - 10}{10}$$
, or $L_s = 110$.

Therefore, for an LED installed on a light-gray panel and used in this lighting environment, we see that the minimum acceptable level of Luminance is 110 foot-Lamberts.

Colors. LED's are now available in various colors. In some applications the designer may be called upon to develop circuits in which LED's of different colors are to produce equal Brightness. Since light output from an LED is basically a function of current flow through the PN junction, equal Brightness can be achieved by adjustments of current flow.

Design Example #4: Suppose that three LED's, one each of red, yellow, and green, are to each produce a luminous intensity of 2 mcd when installed in the circuit shown in Figure 12. Further suppose that V_{CC} is set at +5 volts and the LED types chosen are MV5053 (red), MV5353 (yellow), and MV5253 (green).

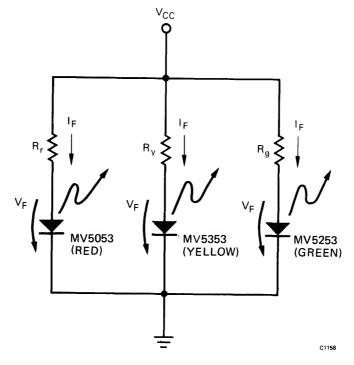


Fig. 12. Brightness Matching Different Colors

First the values of I_F needed to produce 2 mcd in each LED must be determined. From the data sheets we are given that the MV5053 typically produces 1.6 mcd when I_F is 20 mA; the MV5253 produces 1.5 mcd when I_F is 20 mA; and MV5353 produces 6.0 mcd when I_F is 20 mA. The brightness— I_F relationship for LED's can be assumed to be linear for I_F values within the maximum ratings. Therefore, knowing these points and that the luminous intensity is zero when I_F is zero, we can plot the straight-line relationship for each LED type (see Figure 13). From these plots we see that the MV5053 produces 2.0 mcd when I_F is 25 mA; the MV5253 when I_F is 26 mA; and the MV5353 when I_F is 7 mA.

Now the resistor values for $R_{\text{r}},\ R_{\text{y}},\ \text{and}\ R_{\text{g}}$ can be calculated using Equation 2.

$$R_L = \frac{V_{CC} - V_F}{I_F}$$

with V_{F} taken as the "typical" values given on the data sheets. We then have:

$$R_r = \frac{5 - 1.65}{.025}$$
 $R_y = \frac{5 - 2.1}{.007}$ $R_g = \frac{5 - 2.2}{.026}$

$$R_r = 134$$
 ohms $R_v = 414$ ohms $R_g = 108$ ohms

It should be noted that the foregoing analysis holds true only as long as spatial distribution (beam pattern) and apparent image size are very nearly the same for all LED's, regardless of color.

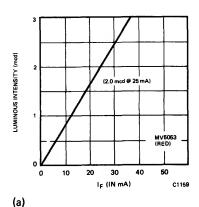
Infrared LED Sources. Visible-emitting LED's, the vital link in the man-machine interface, are characterized in terms of Photometric quantities. On the other hand, infrared-emitting LED's (whose invisible light is of wavelengths longer than 750 nanometers) are characterized in terms of Radiometric quantities. Also, applications requirements for infrared LED sources are different from those for visible-emitting LED's. Whereas for visible-emitting LED's a wide viewing angle is normally important, for infrared sources a narrow beam width and high on-axis intensity are normally important. Light output produced by infrared sources is defined by one or more of the following Radiometric parameters (see Table 3):

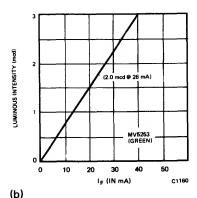
Radiated Output Power (P) or (ROP)—Total output of the device in all directions (measured in Watts).

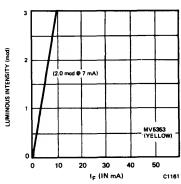
Radiant Intensity (J)—Radiant flux per unit solid angle in a given direction (measured in Watts/ steradian).

Irradiance (H)—The density of radiant flux incident on a surface (measured in Watts/area).

Irradiance is a particularly useful parameter because it describes how much output power is available at a given







(c)

Table 3.

	Parameter and Symbo		Definition	Units	Abbrev.
RADIOMETRIC	Radiant Energy	Q		erg joule calorie kilowatt-hour	J cal kWh
	Radiant Flux	Р	$P = \frac{dQ_e}{dt}$	erg per second watt	erg s ⁻¹ W
	Radiant Emittance (see Note 2) Irradiance	н	$W = \frac{dP}{dA}$ $H = \frac{dP}{dA}$	watt per sq. cm, watt per sq. m, etc. watt per sq. cm, watt per sq. m, etc.	W cm ⁻² W m ⁻² W cm ⁻² W m ⁻²
	Radiant Intensity $J = \frac{dP}{d\omega}$ (see Note 1)		watt per steradian	W sr ⁻¹	
	Radiance (see Note 1)	Z	$N = \frac{d^{2}P}{d\omega(dA\cos\Theta)}$ $N = \frac{dJ}{(dA\cos\Theta)}$	watt per steradian and sq. cm watt per steradian and sq. m	W sr ⁻¹ cm ⁻² W sr ⁻¹ m ⁻²
PHOTOMETRIC	Luminous Efficacy	κ	K = F	lumen per watt	im W ⁻¹
	Luminous Efficiency	v	$V = \frac{K}{K_{\text{maximum}}}$		
	Luminous Energy (quantity of light)	o,	$Q_{v} = \int_{380}^{760} 760 \text{ K}(\lambda)Q_{e}\lambda d\lambda$	lumen-hour lumen-second (talbot)	lm h lm s
	Luminous Flux	F	$F = \frac{dQ_v}{dt}$	lumen	lm
	Luminous Emittance (see Note 2) Illumination (illuminance)	L	$L = \frac{dF}{dA}$ $E = \frac{dF}{dA}$	lumen per sq. ft footcandle (lumen per sq. ft.) lux (lumen per sq. m) phot (lumen per sq. cm)	lm ft ⁻² fc lx ph
	Luminous Intensity (candlepower)	1	$I = \frac{dF}{d\omega}$	candela (lumen per steradian)	cd
	Luminance (brigh tness)	В	$B = \frac{d^2 F}{d\omega(dA\cos\Theta)}$ $B = \frac{dI}{(dA\cos\Theta)}$	candela per unit area stilb (candela per sq. cm) nit (candela per sq. m) foot-Lambert (cd per π ft ²) apostilb (cd per π m ²) Lambert (cd per π cm ²)	cd in ⁻² , etc. sb nt ft-L asb L

2. W and L refer to "emitted from" and H and E refer to "incident on"

NOTES: 1. ω is a solid angle through which flux from point source is radiated

 $[\]boldsymbol{\Theta}$ is angle between line of sight and normal to surface considered

 $[\]lambda$ is wavelength

distance away from the LED. Designers often make use of this parameter when choosing their infrared detectors. Silicon "solar cell" or "photovoltaic cell" detectors are the best detector choices because they generally have

large active areas, good long-term stability, and nearperfect match in spectral response compared with infrared LED sources, (see Figure 14).

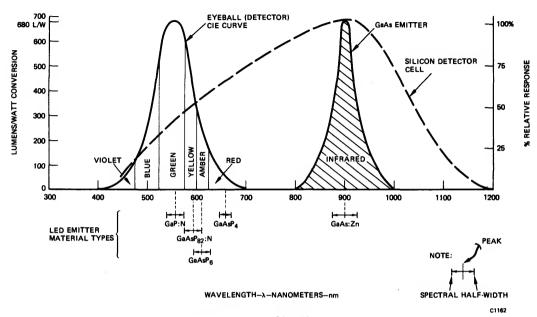


Fig. 14. Relationship Between LED and Detector Spectrums

AN302 using LED's to replace incandescent lamps

High-density configurations of high-intensity incandescent lamps can generate considerable heat. For example, a 10-by-10 bank of miniature 50-volt lamps can dissipate 200 watts. The resulting heat can cause catastrophic damage to mounting sockets, shorten life of insulation material, weaken structural material, and make lamp replacement almost hazardous. LED's, on the other hand, not only ruh cooler but also use less power and have longer life. This Application Note points out some important electrical design considerations when using LED's as indicator lamps. Circuits that assure low power dissipation and protection for the LED's will be shown.

Note from the Editor: The author of this Note wrote from a point of view which subscribed to socketing off-the-shelf LED's. He realizes that various methods can be used to prohibit the inverse insertion of a polarized device into a symmetric socket, but chose to ignore these means for exemplification.

DEVICE MAXIMUM RATINGS

As in any circuit design, care must be taken not to exceed the maximum ratings of the components. In the case of LED's used as indicator lamps, the main absolute maximum parameters to be considered are Continuous Forward Current, IF, and Reverse Voltage, VR. Wellengineered circuit designs should protect the LED's from the consequences of being plugged into a socket in the reverse polarity, damage arising from voltage transients on the power supply, and inductive kicks of solenoids or relay coils. Table I lists some of the absolute maximum ratings for a typical LED solid-state indicator lamp, the MV5054-2.

MV5054-2

Absolute Maximum Ratings at 100°C		Units
Reverse Voltage, V _R	5.0	٧
Continuous Forward Current, IF	15.0	mΑ
Peak Forward Current, IP	6.0	Α

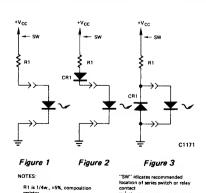
Table I. Absolute Maximum Ratings of a Typical LED

SUPPLY VOLTAGE LESS THAN LED'S V_R MAX. RATING

The simple circuit shown in Figure 1 can be used in applications that have a DC supply voltage equal to or less than the $V_{\rm R}$ maximum rating of the LED. The resistance value of R1 can be calculated from the expression R = 100 ($V_{\rm CC}$ – 2) when the IF of the LED is to be 10mA. If the LED is plugged in so as to effect reverse polarity, no prohibitively high current flows since $V_{\rm CC}$ does not exceed the $V_{\rm R}$ max. of the LED.

Now consider what happens in Figure 1 if transient voltage spikes appear on the power supply line. Positive-going spikes cause $I_{\rm F}$ to increase, but cause no device problems since LED's can withstand very large positive-going spikes of short duration as they have extremely high Peak Forward Current, $I_{\rm P}$, ratings. As long as the amplitude is less than $V_{\rm CC}$, negative-going spikes merely reduce $I_{\rm F}$; if greater than $V_{\rm CC}$ have large and device damage can result. Those applications in which negative-going spikes of amplitude greater than $(V_{\rm R}+V_{\rm CC})$ can occur should have a silicon diode added, either in series (Figure 2) or in parallel (Figure 3) with the LED.

The "+V_{CC}" of Figures 1, 2, and 3 just described can, of course, be half-wave or full-wave rectification as well as DC (provided that the peak does not exceed +5 volts).



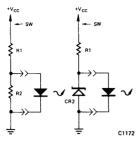


Figure 4 Figure 5

NOTES: R1 is 1/4 to 1 w., ±5%, composition resistor R2 is 1/4 w., ±5%, composition resistor CR2 is 5 volt, ±20%, 250 mw., low-cost zene "SW" indicates recommended location of series witch or relay contact "=" indicates ground return of +Vccor outp

SUPPLY VOLTAGE GREATER THAN LED'S V_{R} MAX. RATING

An LED plugged in the inverse polarity in Figure 1, 2, or 3 can be damaged by high $I_{\rm R}$ if the supply voltage is greater than the $V_{\rm R}$ maximum rating of the LED. To protect against possible damage, an additional component must be added. Figure 4 shows a circuit having an additional resistor, R2, whose function is to limit the voltage drop to the $V_{\rm R}$ max. of the LED when no LED is plugged in.

DESIGN EXAMPLE: Suppose that an MV5054-2 LED is to be used in an application having a V_{CC} of 50 volts and an I_F of 10mA. When no LED is plugged in, R2's voltage drop is to be less than 5 volts (the V_R maximum rating listed in Table I for a MV5054-2).

Standard values of 3300 ohms for R1 and 360 ohms for R2 are obtained from a simple Thevenin's Theorem equivalent circuit, as:

$$\frac{V_{R \text{ max.}} - V_{F \text{ (typ.)}}}{I_{F}} = \frac{R1 \text{ R2}}{R1 + R2}, \text{ where } R1 = 9 \text{ R2}$$

$$\frac{5 - 1.8}{.01} = \frac{R1 \text{ R2}}{R1 + R2} = \frac{9 \text{ R2}}{10}, \text{ etc.}$$

Note that Figure 4's circuit also provides protection against damage from negative-going voltage spikes of amplitudes greater than V_B + V_{CC}).

The circuit shown in Figure 5 can protect the LED against incorrect socketing as well as against voltage spikes of virtually any amplitude. The value of the zener diode's breakdown voltage is chosen to be less than the V_R maximum but greater than V_F maximum of the LED. When no LED is plugged in, the zener conducts with a breakdown voltage less than V_R . An LED plugged in with the wrong polarity is not stressed because the voltage applied across its terminals is less than its V_R

maximum rating. Figure 5's circuit provides protection against negative-going voltage spikes since a spike of amplitude greater than V_{CC} put the zener into forward conduction, holding the reverse voltage across the terminals of the LED to no more than one volt.

Notice that the "+V_{CC}" of Figures 4 and 5 can be half-wave or full-wave rectification (or for that matter just plain AC) so long as the peak voltage does not exceed 50 volts. Figure 4, if driven by AC, gives an effect that the LED is non-polarized and will operate no matter how inserted in the socket.

HIGH-DENSITY LAMP CONFIGURATIONS

At the beginning of this application note it was pointed out that a 10-by-10 bank of miniature 50-volt incandescent lamps can dissipate 200 watts. Besides running cooler than incandescents, LED indicator lamps can be used in circuit designs that reduce power dissipated at the socket. Consider the circuit shown in Figure 6 for a 20-lamp bank operating from a 50-volt, ±5% power source. Here the Q1, CR3 portion of the circuit acts as an equivalent 40-volt zener, and can be located easily on a heat sink remote from the lamp sockets. The amount of power dissipated at each socket—LED plus resistors—is less than one-fifth watt, rather than the incandescent lamp's two watts.

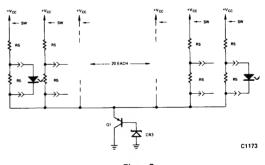


Figure 6

NOTES: R5 is 680 ohm, 1/2 w., ±5%, composition resistor Q1 is 10 w., PNP transistor CR3 is 39 volt, ±5%, 1 w. zener
"SW" indicates recommended location
location of series switch or relay
contact

Although an MV5054-2 LED has been used in all circuits shown in this application note, the same design considerations apply to other LED types as well.

AN303 MOS logic level indicator

A very low current LED has been developed that is capable of being driven directly from MOS and COS integrated circuits. Designated the MV55, this visible red LED incorporates a new chip, specially designed for operation at low current levels. The MV55 typically produces a Brightness of more than 100 ft-Lamberts from a Forward Current of only 1 mA. This Brightness is adequate for indicating binary logic level, especially in the subdued ambient lighting environment commonly found within cabinet- or chassis-mounted equipment.

ELECTRICAL CHARACTERISTICS

The Brightness versus Continuous Forward Current relationship for a typical MV55 is shown in Figure 1. In steady-state operation the MV55 has an absolute maximum Continuous Forward Current rating of 4 mA, and in pulsed operation (with one microsecond pulse width

and 0.1% duty cycle) an absolute maximum Peak Forward Current rating of 400 mA. For Reverse Voltage the MV55 has a 3.0 volt absolute maximum rating, and "turn-on" and "turn-off" times (with a one-ohm load impedance) are typically one nanosecond, (10-9 seconds).

MECHANICAL CHARACTERISTICS

The MV55's package has an axial-lead form factor (see Figure 2). Its very small size minimizes space requirements, permitting high-density P.C. Board layouts. The MV55 is simple to install, since mounting sockets or other hardware are not required. The ribbon-type leads can be either soldered or welded. The low profile of the package enables edge-board or flat-board mounting. (Arrangements can be made to have leads custom prebent prior to shipment from the factory.)

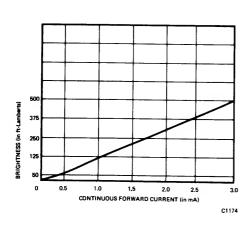
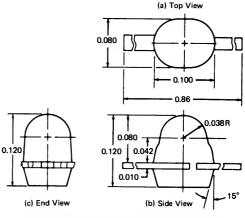


Fig. 1. Brightness versus Continuous Forward Current for typical MV55



NOTES: 1) DIMENSIONS SHOWN ARE NOMINAL VALUES (IN INCHES)
2) DOTTED LINES INDICATE CENTRAL MECHANICAL AXIS

Fig. 2. MV55 Package

C1175

LENS CHARACTERISTICS

The MV55 has a red, fully-diffused plastic lens which collects the LED output into a narrow spatial distribution pattern (see Figure 3). For MV55 devices the axis of spatial distribution is typically within a 10° cone with reference to the central mechanical axis of the package. This lens assures high Luminous Intensity along the axis of spatial distribution.

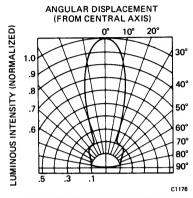


Fig. 3. Spatial Distribution Pattern for MV55

BASIC CIRCUITS

Some basic circuits for the MV55 are shown in Figure 4. Note that this LED does not require buffering or interface stages, but merely connects directly to the IC output. The choice between the circuits shown in Figure 4a and 4b is made according to whether the LED is to light when the IC output state is at logical "1," or at logical "0." In Figure 4c's circuit the MV55 not only performs as an indicator, but also presents a high impedance to the TTL gate when the MOS output is at logical "0."

CONCLUSION

This application note has briefly pointed out the main features of the MV55 and has shown circuits in which it can be used. The MV55 not only offers the high reliability and long lifetime inherent in solid state devices, but also has low unit cost.

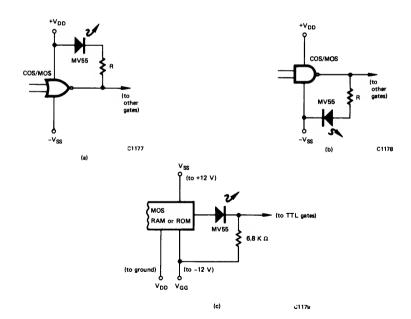


Fig. 4. Basic Circuits for MV55

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